9-1892

The Student: A Journal of Education (Vol. 2, No. 9)

Northern Indiana Normal School

September, 1892. Vol. 2, No. 9.

THE STUDENT

A Journal of Education.

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ENTERED AT THE POST-OFFICE AT VALPARAISO, IND., AS SECOND CLASS MATTER.

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THE STUDENT.

VOL. II. SEPTEMBER, 1892. No. 9.

UP THE RHINE FROM COLOGNE TO WIESBADEN.

MANTIE E. BALDWIN.

OUR party of ten had received accessions. We now numbered sixteen very light-hearted, fun-loving persons. At eight o'clock one delightful, hazy morning, we went aboard a handsome steamer to go from Cologne up the Rhine to Wiesbaden, a day's journey. At the ringing of the wharf bell, the steamer slipped quietly out into the broad, smooth river. The boat was for day service only, and had two dining-rooms on the lower deck, with the engine room between. The entire upper deck was open and covered by an awning. It was fitted up with seats, camp-chairs, and tables on which lunch could be served, if the passengers so desired. The passengers were mainly English-speaking people, tourists like ourselves.

Cologne, the quaint old German city, with its matchless cathedral receded from our view. Lingeringly our gaze rested upon the delicate stone tracery of the tall spires of that great building rising far above all others in the city. Surely there can be nowhere in the world any architecture that charms the beholder more.

And now we were fairly out upon that river famed in tradition and history. With what thrills of expectation we looked forward to the ride! For years we had read and thought of it. Would it excel or even equal our own lordly Hudson in beauty or interest? We loyal Americans almost resolved that it should not, in our hearts at least. Comfortably seating ourselves forward, we critically waited for the panorama to unfold.

The river, smooth and greenish-yellow in color, moved majestically toward the sea. Our steamer rapidly glided up the center of the channel toward the distant highlands. The scenery is somewhat commonplace till Bonn with its great University buildings comes in sight. The romantic and picturesque portion of the Rhine is between Bonn and Bingen.

Shortly after leaving Bonn, we came in sight of the Drachenfels. Gladly would I tell the legend of this Dragon's Rock and its famous ruined castle, did space and time permit. We looked upon it, this ruin old, with curious eyes. It towers up boldly above the water as if forbidding further passage up the

stream. In the side of the crag or mountain yawns the mouth of the stone quarry whence the rocks were taken for building the Cologne cathedral. On the opposite side of the river, but a little farther up, is Rolandseck, another ruin with another wild tradition. In the middle of the river, at this point, lies a low island on which once stood a nunnery.

One after another, in quick succession, objects of interest presented themselves; but, to our disappointment, the highlands had thus far held themselves aloof from the river, and we rather gladly decided that the highlands of our own dear Hudson were far loftier and finer. And these lower highlands of the Rhine were more sloping, and green to the summits, with but few rocks or projecting crags.

Twice were our eyes gladdened by the sight of our beautiful banner, the stars and stripes. Once floating over a handsome villa in which some Americans were summering. As we passed, we rapturously waved hats, and handkerchiefs, and the flag was twice lowered and raised in response to our enthusiastic salute. Once waving from a flagstaff above a great ruined castle, near which stood the magnificent chateau of an enterprising German from New York City, a wealthy man who loved his father-land, but did not forget to honor his adopted country by raising her flag over his summer home.

Stolzenfels, near by, once a famous ruin, rises prominently on a mountain side. It is now splendidly restored and occasionally occupied by Germany's Emperor.

Onward swiftly we passed from point to point till Coblenz, a thriving city came into view. At this place the Moselle flows into the Rhine, and is spanned by an imposing bridge. There are few bridges over the Rhine, but at this place there are two; the one named above, and a pontoon bridge. Just as our steamer passed under the high one, a section of the pontoon bridge, two or three boats fastened together, swung around as if by magic, and as quickly swung back behind us, making complete the substantial chain of boats spanning the river. At Coblenz is a fine modern castle, one of the summer homes of the Empress. Opposite, and on a beetling, frowning crag overlooking both the Moselle and the Rhine, is what is said to be the most impregnable fortress in all Europe. Built hundreds of years ago, on the site of an old Roman fort, it still stands in perfect preservation and is occupied by the troops of Prussia. Never has it been taken in all the numerous sieges, except twice when the pangs of hunger drove the brave defenders down from its fastnesses. Seeming to be a part of the mountain, and embedded in its rocks, Ehrenbreitstein breaths defiance on all its country's foes.

From here the banks of the river recede somewhat, the hills grow softer and finally flat country appears. We drew back from our intense gazing with a feeling akin to disappointment. The Rhine may have its castles, we thought, and its wild traditions, but our Hudson has grander highlands, and the blue heights of the Kaatskills with the never-dying Sleepy Hollow legends are far dearer to our hearts.

But we were yet to see. The Rhine had given us a taste of its greatness and then withdrawn itself, only to come forth in grander strength and magnificence. A few miles of this rest period of lowlands, and with a sharp turn, we were in the midst of far finer views than our imagination ever pictured.

A special pilot now came aboard to

guide our vessel through this more dangerous portion of the river. There is no whistle on these river steamers. A musical bell is rung, or rather chimed while passing the villages at which no stop is made, and also for those points where the steamer lands. The sound is clear and beautiful amid the stillness of those mountains.

The crags and mountains now forced themselves upon us. The great river narrowed and fretted past these towering guardians of its way. Castle after castle, in various stages of decay and ruin appeared on the most prominent, isolated and inaccessible crags. They peered at one another up and down the river. Some built hundreds and some two thousand years ago; some by the all-conquering Roman, some by bandits and robbers; and the more recent ones by the persecuted Germans, there they stand, monuments of the struggles, fears, and defeats of their builders. Napoleon's ruthless hand destroyed many that till his time had withstood all foes. Bitter and hard and long must have been the struggles within and without those almost impregnable and inaccessible walls. Barbarian and trained soldier alike perished there. With mingled feelings of admiration and regret, admiration of those picturesque ruins, and regret for the necessity that compelled their erection and destruction, we gazed upon the strange and impressive scenes. Swiftly the boat hurried us on. The hazy morning had changed to a bright and sunny afternoon. The clear pure air stimulated hearts and brains. With speechless lips and wide-open eyes we drank in the magnificence of the entrancing scene. Again the river narrowed. Again the heights became more precipitous and lofty, the shadows more intense below the crags. The castles stood out more sharply defined against the deep blue sky. God's blessed sunshine poured itself over and into each cliff and crevice in rock and mountain.

Another special pilot was taken aboard, for we were nearing St. Goar, a town on the most dangerous and narrow part of the river. The water, here seventy-five feet in depth, pushed onward tempestuously through the narrow gorge. Rheinfels, the largest and most interesting ruin, reared its massive walls above the picturesque old German town, St. Goar, nestling at the base of the crags. The river behind us was shut from view by the resolute mountains thrusting themselves forward; another sharp bend in the stream before us prevented our seeing beyond. The river foamed and roared like an imprisoned creature. For a moment only did our steamer touch the little wharf; for a moment only did our eyes rest upon the people passing from the vessel to the narrow streets of the village; a moment more for the last glance at all the majesty and beauty of the scene, the grand heights, the ruined castle of the past, the smiling peaceful village of the present, and we were swept onward up the river.

Past scene after scene almost as fine we swiftly went, in the light of the slowly descending sun. On these highlands and mountain sides, reaching up to and about the ruins are terraced vineyards and small patches of grain and vegetables. These thrifty German people, women and men, girls and boys, were working and laughing in the sunshine. A curious meeting of the present and the past! Where once only war and desolation reigned, now peace and prosperity prevail. Civilization's triumph over barbarism. No longer ago than eighteen

hundred seventy, the boom of the cannon and the roar of musketry echoed and re-echoed among these crags and down this beautiful river. But now the rule of arbitration has begun, and though the soldier stands on guard at the numerous fortresses, surely it is more to sustain the military pride of Germany's people than for the purposes of war.

Passing the Lorelei, the crag from which a siren once sang so charmingly that the unwary boatmen, in yielding to the enchantment of her song, were lured to their death in the hungry waters below, we came to a castle handsomely rebuilt and owned now by the Emperor and his brothers. It stands commandingly on an isolated point and is surrounded by dense forests, an unusual sight, for as I said above, wherever there is a handfull of earth or a footing on these heights, it is cultivated.

At last, just as the sun was sinking, we came to Bingen, the "fair Bingen on the Rhine." A lovely village amid gentle slopes of golden grain and soft green vineyards, and guarded by two monuments of recent erection, it formed a fitting terminus to the grand scenery through which we had been all day passing. From there onward, we moved up the again broad and smooth river with very low land on either bank, till, in the late twilight, we landed at Biebrich, the nearest river point to Weisbaden. Just below this village is Johannisberg, the great estate where the most celebrated Rhine wine is made. Its sunny slopes are covered with grape vines of choicest variety. So choice indeed that when the grapes are gathered, the vintagers are guarded by soldiers lest they eat some of the precious fruit. So valuable is the wine that one small bottle costs fifteen dollars, and there is little to sell at that price, for it is kept for Germany's royalty.

At Biebrich there are large barracks; on the roof of which are placed some images. During the Franco-Prussian War, the French soldiers on the opposite side of the river, thinking the images to be men, fired upon them. The result is that one stands headless and another without a leg, a grotesque sight.

Leaving the steamer at Biebrich, we took carriages for a drive to Wiesbaden, three miles distant. The road is excellently paved, and has two rows of shade trees on each side. We enjoyed the drive in the starlight, and instead of going to our hotel, went at once to the great pleasure grounds of Wiesbaden, one of the most fashionable summer resorts in Germany.

Here are the hot springs that afford healthful drink and baths for invalids. Here are the fine hotels and villas, and drives, and pleasure grounds, an European Saratoga. In the pleasure grounds are pavilions of enormous size, solidity, and beauty. They are fitted up with inlaid marble floors and soft carpets, with walls and ceilings adorned with most elaborate ornamentation of gilding, bas-reliefs, and frescoes. Mirrors, at every turn, reflect the thousands of lights from massive chandeliers; great columns of marble or stone support the high dome-like ceiling. At back and front, the pavilions are entered through lofty porticos like those of ancient Greece. Everything that money and labor can contribute to the pleasure of an idle people, has been given. This Wiesbaden is for the rich, the idle rich alone. We had visited the pleasure resorts of the poor in Germany. We now beheld one of the resorts for the wealthy.

Passing through the pavilion, we entered the pleasure ground itself. It was a lovely little park with stately trees, fine promenades, bowers, and grottoes; and in the center a beautiful little lake with the branches of the trees drooping above. Beds of fragrant flowers were here and there. Two orchestras, one of horns and one of stringed instruments, played entrancing music. Printed programmes of the music were enclosed in frames and glass and hung in convenient places about the grounds. Clusters of arc-electric lights made night day. It was a gala night, so the illuminations were unusually fine. Thirty-nine arches and one great shield of incandescent lights spanned the promenades around the lake. These lights were all inclosed in tulip-shaped globes of various colors, adding to the beauty of the scene. Above each arch was a cluster of small lights, each different in design. Beautifully dressed people were wandering everywhere and listening to the music, not chattering as we do at open air concerts in America. Near the portico of the pavilion were many small tables around which people were seated and eating or drinking.

Presently the arc lights were shut off, the music played more softly and the display of fireworks began. Out on the lake platforms had been built and from these the fireworks were sent up. Many of these were similar to those seen in America. Lohengrin in her chariot drawn by swans, moved slowly and majestically across the lake. Paddy, with his wheelbarrow, walked twice out over the water and back before he was entirely consumed. But the most novel and interesting display of the evening was a cannonading scene. On opposite sides of the lake, red, green, and white tableau lights were thrown up until the whole space over the water was in a glow like fire. Innumerable fiery arrows darted about in the upper air, a great column of water rose from the center of the lake in a mass of spray up through the roseate, cloudy air, an interminable din of cannon and musketry sounded above and around, while the orchestra played lively martial airs, to make it seem like a real conflict we were witnessing. When it was ended, the thousands of spectators turned quietly away. What a tumult of applause would have followed such a display in America! Here the people went silently to their homes, and we to our hotel to meditate over the difference in the way things are done in Europe and in America.

SCIENCE OF TO-DAY.

PRINCE KROPOTKIN.

IV.

WHEN Schwann, closely following upon Robert Brown's and Schleiden's work, published in 1839 his famous *Microscopical Researches*, and came to the conclusion that all possible tissues of both animals and plants consist of cells, or of materials derived from cells, it seemed that the primary units—the molecules, so to say—of which all living beings are built up, had finally been discovered. A small piece

of structureless, granulated, jelly-like substance—the sarcode in animals and the protoplasm in plants—surrounded or not by a thin membrane, and containing a nucleus, this was the primary unit, giving origin to all the most complex and varied tissues.

This conception evidently gave a formidable impulse to science and to scientific philosophy altogether, the more so as it was soon followed by a most important discovery which established the close resemblance existing between the subdivision of cells and the phenomena of sexual reproduction in plants and animals. Twenty-two years later, another still more important step was made in the same direction, when Max Schultz published his memoir *Das Protoplasm*, and proved that the granular, jelly-like substance of the cells is identical in both the animal and vegetable kingdoms; that it is the very seat of all physiological activity, as it is capable of movement, of nutrition, of growth, of reproduction, and even of sensibility, or, at least of irritability. Many must certainly remember the effect produced by the broad generalizations based upon Max Schultz's ideas by Haeckel in Germany and Mr. Huxley in England, in his well-known lay sermon *The Physical Basis of Life.*

However, if protoplasm were the seat of physiological activity; if it could move, grow, reproduce itself, and display irritability, was it still to be considered as a "structureless, granulated jelly or slime"? It was a world in itself, and the microscope had to be directed towards the further study of this world. So it was, by Lionel Beale, Schultze himself, Strasburger, and most histologists of renown. Discovery upon discovery was the reward of this work, and the recent researches of Strasburger, Flemming, Guignard, and Fol, while fully confirming the broad generalizations laid at the foundation of modern biology, revealed a wide series of new facts having a direct bearing upon the question of heredity, which is so much debated now in connection with Weissmann's views.

It appeared, first, from the above-mentioned researches, that protoplasm itself consists of, at least, two different substances; one of them being a minute network of very delicate fibrils, while the other is an apparently homogenous substance filling up the interstices between the network. Then it became evident that the nucleus which makes a necessary constituent part of cells, has a still more complicated structure, and that it plays a most prominent part in all the phenomena of subdivision of the cells and those of reproduction. It consists of a nuclear plasm, surrounded by a very thin membrane; it contains very often a still smaller nucleolus; and within the nuclear plasm the microscope discovers extremely thin threads or fibres, consisting in their turn of extremely thin minute granules, or spherules—the whole appearing as a ball of thread coiled up somewhat roughly. This being the usual aspect of the nucleus, a series of modifications begin within it, when the moment comes for a cell to subdivide. The nucleolus disappears; the beaded threads, or fibres, shorten and become thicker. They take the shape of minute hooks, and these hooks join together (by the tops of the bendings) in one point, the pole. By the same time the membrane of the nucleus is reabsorbed, and the surrounding protoplasm of the cell penetrates within the nucleus, thus mixing up to-

gether with the nuclear plasm. Thereupon a most important change follows. Each of the thickened nuclein fibres, or threads, splits in its length, and the number of the threads being thus doubled, one half of them is attracted towards a radiated spindle-figure in one part of the cell, while the other half arranges in the same way in its opposite part. The two radiated figures thus separate, and only then (if the nucleus subdivides in giving origin to two new cells) a membrane, or parts of a membrane, grow between the two. After the separation, the fibres either coalesce with their ends, or return to the shape of a ball of thread.

It is a whole world undergoing a whole cycle of modifications. And yet this is not all. It appears from Strasburger's work that all the cells are not quite similar, but that the number of nuclein fibres varies from eight to twelve and to sixteen in various families of plants, the individuality of the types thus seemingly depending upon their number; while Guignard found that with several plants the cells which will be destined, after the division of the mother cell, to become the reproductive organs will always have but one-half of the normal number of fibres (say, twelve), while those which are destined to become the vegetative organs will have the full number—say, twenty-four. The former will acquire the full number of fibres only after fecundation. Are, then, the cells differentiated from the first moment of their bi-partition? And what part does the number of chromatine fibres play in that differentiation?

Further complications are discovered through the study of the protoplasm itself. It was known some time ago that there are, in the animal cells, two peculiar spots, surrounded by rays of sarcode, which were named spheres of attraction, or directing spheres, or centrosomata, or simply "centres." The same minute centres have now been found by Strasburger and Guignard in vegetable cells also, and it appears that these bodies, essentially belonging to the protoplasm—not to the nucleus—take a leading part in the phenomena of reproduction. Professor Fol, who carried on his researches with eggs of sea-urchins, saw that when the elements of the male cell have entered the female cell, the centre of the former separates from the top of its nucleus and joins the centre of the latter. Both lie close to one another; then they become elongated and take positions on the opposite side of the nucleus, which is now formed by both coalesced nuclei, surrounded by a radiation of the fibrils of protoplasm. Then begins what Fol names "the quadrille of the centres." Each of them divides into two half-centres, and all four move, so that each half-centre of the male cell meets and coalesces with one half-centre of the female cell, and the two newly formed centres become the poles of attraction for the spindles of the nucleus. The act of fecundation is thus not a simple coalescence of two nuclei, originated from two separate individuals, as was supposed before; it also consists of the union of each two of the four half-centres originated in the protoplasm.

The interest attached to these minute changes is great, on account of their consequences as regards the theory of heredity. The observations of Fol, and the quite analogous observations of Guignard as regards plants, would only confirm the doubts expressed by Sir William Turner in his address before

the Microscopical Society, as to the germ plasm being "so isolated from the cells of the body generally as to be uninfluenced by them, and to be unaffected by its surroundings;" and they would give further weight to his restrictions as regards Weissmann's theory of heredity. However, the questions at issue are so complicated and so delicate, that further research is wanted, and eagerly expected by specialists.

But what is protoplasm itself? What is this jelly-like matter which exhibits all phenomena of life? Science has not yet given a positive answer to this great question. On the one side, we have the germs of an opinion, shared by some biologist who are inclined to see in protoplasm an aggregation of lower organisms. Thus, R. Altmann and I. Straus consider that the granulations of protoplasm are the essential and fundamental elements of the organic being. As to the cell, it is not, in Altmann's view, an elementary organism, but a colony of of elementary organisms which group together according to certain rules of colonization. They constitute the protoplasm as well as the nuclear plasm, and they are the morphological units of all living matter. These granules, he maintains, are identical with microbes; their shape, their chemical reactions, their movements, and their secretory functions are similar; but the granules of the protoplasm differ from bacteria in not being capable of a separate existence. They can only live in cells. It is absolutely impossible to say, at the present time, how far this view may find support in ulterior research, though it must be mentioned that it is derived from elaborate investigations into the cells of various glands and their secretions, and that it finds support in facts accumulated by many well-known anatomists. It must also be added that some biologists—namely, J. C. Vogt—go a step further and maintain that all micro-organisms, and all cells of more complicated organisms, are structures of a fourth or higher order; they are colonies of "polyplasts," which themselves consist of "monoplasts," or those granules which are distinguished in the protoplasm and the nuclear plasm. But, on the other side, we also have the other extreme view, supported by the authority of Professor O. Butschli, who sees in protoplasm nothing but a foam, quite similar to the foams which may be artificially produced, and who maintains that all phenomena observed in living protoplasm, are simply physical and chemical processes.

The great question as to what protoplatm is, evidently will not be solved soon. But the above-mentioned researches will give an idea of the problems which at this moment absorb the attention of biologists. One important step has certainly been made: the complicated structure of protoplasm has been recognized, and the exploration of the vital processes in living matter now stands on a firm footing.

V.

It is known that Darwin, when he began thinking about the possible origin of the eye, used to feel a kind of shudder in consequence of the difficulties standing in the way. An important step towards smoothing these difficulties has now been made by Professor S. Exner, who has brought out an elaborate and richly illustrated work on the eyes of Crustaceans and Insects, and by Mr. Watase, who has studied the question as to their possible origin. The compound eye consists, as known, of hundreds and

thousands of separate conical, almost cylindrical, parts, each of which corresponds to a separate eye; however, their structure widely differs from that of the mammalian eye. Each of the component eyes has, like ours, a cornua, but it is flat, and the crystalline part of the eye has not the shape of a lens, but of a lens cylinder, that is, of a cylinder which is composed of sheets of transparent tissue, the refracting powers of which decrease towards the periphery of the cylinder. If an eye of this kind is removed and freed of the pigment which surrounds it, objects may be looked at through it from behind; but its field of vision is very small, and the direct images received from each separate eye are either produced close to one another on the retina (or rather the retinulæ of all the eyes) or superposed. In this last case no less than thirty separate images may be superposed, which is evidently a great advantage for nocturnal insects. Many other advantages are derived from the compound structure of the insect eye. Thus the mobile pigment which corresponds to our iris can take different positions, either between the separate eyes or behind the lens cylinders, in which case it acts as so many screens to intercept the over-abundance of light. Moreover, it has been ascertained by Exner that with its compound eye the common glow-worm (*Lampyris*) is capable of distinguishing large signboard letters at a distance of ten or more feet, as also extemely fine lines engraved $\frac{1}{100}$ of an inch apart, if they are at a distance of less than half an inch from the eye. As a rule, the compound eye is inferior to the mammalian eye for making out the forms of objects, but is superior to it for distinguishing the smallest movements of objects in the total field of vision.

All stages of evolution of the eye may be studied among the Insects and the Arachnides. Thus, beginning with the eye of the *Limulus*, Mr. Watase shows how it may have originated from a simple minute cavity in the epithelium. The sensitive cells lie in direct continuity with those of the epithelium, or hypodermis; and a cavity, with a pigment cell therein, and covered by epithelium, may represent the first rudiment of the eye. Later on the cavity deepens, and the roughly conical thickening of the epidermis which fills it becomes the lens cylinder.

A succession of drawings made by Mr. Watase upon the simplest forms of the ocellæ of larvæ and some millepeds perfectly well illustrate the various possible phases of evolution of the eye, from the minute cavities, or ocellæ, which appear in great numbers, closely packed together, to the more complicated eyes described by Exner. We thus have in Mr. Watase's work, confirmed by another work, by M. Kishinouye, a most valuable contribution to the solution of one of the complicated problems of the doctrine of evolution.

We can only mention several very interesting works on the origin of the prickles in various plants, on the effects of high altitudes upon animals, on the compound structure of the higher plants and the effects of atavism, and so on—all resulting from the modern endeavors of many biologists at explaining the origin and development of variations in animals and plants under the effects of their surroundings. A good deal of attention being paid now to the chapter of direct adaptation in the theory of the

evolution of species, many interesting facts are continually brought to light by the work of the modern followers of Lamarck. —*Nineteenth Century.*

PRINCE MADOC'S DISCOVERY.

HUBERT M. SKINNER.

IN this Columbian year, while we commemorate the great and crowning achievement of the Genoese navigator, it should not be forgotten that honors were previously won by others in the same field of discovery.

Until the year 1874 the claims put forth by the Norse in behalf of the Icelandic explorer, Leif Erickson, received little attention in America or in the United Kingdom. In that year the Icelanders celebrated the millennial anniversary of the settlement of their island; and the miniature pageant at Reikiavik drew to that quaint, out-of-the-way nook of the world curious and interested visitors from the United States and from Europe. The king of Denmark was present. Our own country was represented by Bayard Taylor, Cyrus W. Field, and Dr. Isaac I. Hayes. Mr. Taylor has given us a beautiful rendering of the Icelandic song which had been composed in honor of the event by Mathias Jochumson, the native poet. A happy time they had. The bishop of the island preached a commemorative sermon in the cathedral, there was a banquet in the hall of the college, and there was dancing amid great, flaring fires, in the vicinity of the town. The treasures of the schools and of the libraries were brought forth. So great was the interest awakened by this celebration, that scholars everywhere turned their attention to the folk-lore and the old records of Iceland, and as a result the accounts of the earliest recorded discovery of America have been very generally credited. The date assigned to Erickson's discovery is the year 1001 A. D., three hundred and ninety-one years before the era of Columbus.

No such fortunate event has occurred to attract general attention to the early history of the Welsh,—the descendants of the ancient Britons—who inhabit the mountainous region of Great Britain which is known as the Principality of Wales. Yet the people of that picturesque country (who are a sturdy race, and the best miners and iron-workers in the world) possess a great store of interesting history and legend, running away back, I dare not say how far.

The Welsh claim that the lady "Claudia," mentioned at the close of St. Paul's Second Epistle to Timothy, was a native Welsh-woman (ancient Briton), and that she became the first herald of the gospel in the island of Great Britain. The people of Wales claim for their nationality not only the first British missionary, but also the first European discoverer of this continent—for they are not disposed to recognize the Icelanders as being, in the full sense, people of Europe. The Welsh discoverer was a prince, whose name was Mad'oc. The year of his discovery is stated to have been 1170 A. D., or one hundred and sixty-nine years after that of Erickson, and three hundred and twenty-two years before that of Columbus.

The historical basis of this Welsh claim is meager, and has been overlaid with embellishments of legend and of pure fancy. Southey, the former Laureate of England, wrote a poem on the subject, which went far beyond the accepted facts of Welsh annals. How much of real foundation there is for the claim, is a question of considerable interest.

Owain Gwynedd was one of the greatest of the old Welsh monarchs. His capital was at Aberfraw. He reigned from 1137 to 1169. He had nineteen children, seventeen being sons, of whom Madoc was one. Hywell, whose mother was an Irish princess, succeeded to the Welsh throne; for though he was not the oldest, his elder brother was incapacitated for reigning, because of a physical injury. While Hywell was making a visit to his mother's estate in Ireland, his brother Davydd (David) asserted a claim to the throne in view of his unmixed Welsh blood (for Davydd's mother was a Briton), and Hywell was slain, on his return. Davydd became a tyrant, like Macbeth in Shakespeare's play. He slew one of the remaining brothers, imprisoned another, and banished the rest—all except Madoc, who was commander of the fleet. The armament under Madoc's command appears to have been strong enough to oppose successfully the British fleet at the mouth of Menai strait, in a somewhat important conflict which occurred in 1142. Prince Madoc did not wait to experience in his own person his brother's fury, but leaving his embroiled country he set sail for unknown regions to the west of the British Isles. To what shore he went, no one can assert with any certainty. But it is said that he sailed over the broad Atlantic until he reached a vast unknown land on the other side. From the new-found world he subsequently returned to Wales, with glowing accounts of his discovery.

These must have been highly encouraging, for he was able to fit out speedily a second expedition of ten ships and about three hundred people. His brother Riryd, of Ireland, joined fortunes with him. The ships set sail from the isle of Anglesea. A small port about five miles from Holyhead was the scene of the departure. They sailed away—whither? Not one of the number ever returned to Wales, or was heard of more. It has been asserted with much confidence that many Indians have been found in America (generally a long time since), whose language bore so remarkable a resemblance to the Welsh as to be, in fact, a dialect of that tongue, and to indicate clearly their descent from the Welshmen of Madoc's expedition. As to this there has been no little skepticism.

The fate of Madoc will probably never be known. Yet it seems to be well established that his first expedition resulted in a successful cruise over the Atlantic, and in the discovery of an unknown realm in the distant West. Like Erickson's discovery, it led to no practical results; but it is certainly deserving of note as the achievement of a brave and able commander, a heroic soul.

WHY THE SUN SHINES.

PROF. C. A. YOUNG.

SUNLIGHT is many times brighter than any artificial light. Hence has arisen a rather common idea that there is something mysterious about it, that sunlight cannot be explained in the same way as a light of a flame, for instance.

The sun shines simply because it is *hot*—tremendously so. The sun does not shine as fireflies and glow worms do; they give *light* only, without much heat, emitting only rays that affect the eye.

The sun sends off rays of all kinds—not only such as are visible, but others which are invisible and yet are powerful in their action upon a photographic plate, and still others which are equally invisible, but bring an immense amount of warmth to the earth.

The visible rays of the sun—its *light*, in the strictest sense of the word light—form but a small fraction of its whole radiation. Now only very hot bodies act in this way. "Phosphorescent" bodies, which emit visible rays alone without others in their company, may be cool while they shine; not so with those which send out all kinds of rays together.

That the sun is really most intensely hot is directly shown by means of a burning glass.

Many years ago, a great lens of this sort, nearly four feet across, was made in England, as a present to the Emperor of China. Before it was sent off some experiments were made with it, and the results were very interesting and instructive. When properly set up and adjusted, it gathered all the rays that fell upon its broad surface into a small, bright spot called the "focus" (the word means "fire-place"), and there the concentrated heat was so intense that nothing could be found to withstand it. The focus was hotter than the intensest flame we know how to make, so that even lime and platinum melted in it like wax.

Now the point is, that such a focus can never be quite so hot as the surface of the sun itself. In this case it was only about as hot as it would be at a distance from the sun, equal to the moon's distance from the earth.

There is no question that the sun's surface is intensely hot; and if so it must shine of necessity.

Next comes the question: "What makes it hot?"

Until the days of electricity nearly all our artificial lights came from flames in which something was burning; is the sun's surface then, a burning flame?

No, it is too hot to burn.

The very essence of combustion, or burning, is that two or more chemical elements are entering into combination with each other, producing heat in the process. When a stick of wood burns, the oxygen of the air is seizing upon and combining with the hydrogen and carbon that mainly compose the wood; and the molecules of carbon, after their hydrogen partners have combined with oxygen companions, themselves are attracted by other oxygen molecules and

glow and shine for a while until consumed and converted by the new union into the so-called carbonic acid.

Now this combination of oxygen and carbon produces a certain fixed temperature, which can never be exceeded by a flame involving those materials; and if the melecules of oxygen and hydrogen, or of oxygen and carbon, come together at a higher temperature, *i. e.*, in some place where it is already hotter than they could make it by their union, they refuse to combine. Nay, further, if vapor of water, or carbonic acid gas be exposed to such a temperature, their composite molecules come to pieces, so to speak—to use the technical term, the hydrogen and oxygen, or the carbon and oxygen are "dissociated"—to combine again as soon as the temperature falls sufficiently.

Now the sun's surface is in all probability hotter than the "dissociation" temperature of any elements known to be present there; and this is what we mean by saying that the substances of the sun are "too hot to burn."

But there are other ways than burning by which heat may be generated and the temperature raised beyond any limit known.

A smith, by hammering a nail, with proper precautions can make it red hot. In boring a hole with a gimlet, both wood and gimlet are heated. Sometimes car axles are heated by friction till they set the car on fire. In compressing air for certain machinery, it is made intensely hot, so that means have to be used to prevent its doing damage.

Now it is believed that the sun is a great ball of gases and vapors, kept hot by its shrinkage in size.

There is no question that the shrinkage of such a ball under the force of the mutual attraction of its particles must heat it. It can be proved mathematically—it is not a matter of mere guesswork or opinion—that if the sun is now shrinking at such a rate that its diameter diminishes more than about 300 feet a year, it must be growing continually hotter. If the shrinkage is less than this it may be cooling off slowly.

Almost all astronomers agree in supposing that at one time, ages ago, the sun was a great whirling nebula or cloud, filling the whole space now occupied by the solar system, and that the system has come into its present condition by the slow condensation of this primeval cloud. The smaller globes—the planets—have solidified and ceased to shrink to any great extent, and so have cooled down more or less completely, like the earth. But in the great central globe the process is not finished, and is not likely to be for millions of years to come, so that it still glows with a fiery heat that no furnace can rival, and blazes with a brilliance more dazzling than any human art can produce.

For myself, I do not think it necessary to look farther for an explanation of the intensity of sunlight.

But there are some who do not feel quite satisfied and are disposed to call in the aid of electrical action.

It is true, of course, that a thing can be heated, and that to a temperature beyond any known limit, by passing through it an electrical current of sufficient intensity. The carbon filament in an electric (incandescent) lamp is not "burning," but is made hot and luminous by the current flowing through it.

Those, therefore, who are dissatisfied with the mechanical explanation of the solar heat as produced by shrinkage, maintain that the sun's light is generat-

ed by intense electric currents circulating on its surface.

It would take too long to show why this is hardly likely, and the discussion would not be suited to these columns; but there is no way known in which electric currents of sufficient power could be made to act over the whole surface of a sphere at once, nor any reason to suppose that it can be done. Still, it is quite possible, and even likely, that the exceptional brilliance of small portions of the surface here and there may be caused, in part, by some action of the sort, adding intensity to the light due to the general heat of the luminous shell.

—*Chicago Inter-Ocean.*

THEORIES OF GLACIER MOTION.

H. N. HUTCHINSON.

THERE are few subjects in physical geology which have excited more interest than that of the motion of glaciers. Ice is a very peculiar substance; and some of its properties appear so contradictory to others, that scientific men of high attainments have been greatly puzzled by its behavior as manifested in glaciers. Hence when we come to consider how, or why, glaciers flow down their valleys, we find a great diversity of opinion. Readers of *Knowledge* may therefore be glad to have a brief account of the different theories of Glacier motion which have from time to time been brought forward, together with some indication as to their relative merits.

First, with regard to the origin of the ice itself; most of our readers will be aware that glaciers are fed by the snow-fields above them. So it may almost be said that a glacier is snow at one end and ice at the other. How then does the change from snow to ice take place? Pressure, as every school-boy knows, will convert a handful of newly-fallen snow into a hard mass, and if the pressure be continued, the hardened snow will become ice. It is partly this property of snow which makes a glacier, or ice-river possible. When snow has accumulated to a considerable depth, its own weight squeezes down its lower strata; and the underlying portions of snow are finally compacted together until they become true ice. But another cause is at work helping to bring about the same result. By day, when the sun shines upon the snow, or warm air passes over its surface, the surface layer gets partially melted, the water thus formed trickles down into other snow below, and there solidifying, when night comes and a fall of temperature takes place becomes part of the great mass of ice. Summer and winter act in the same way as day and night, so that much of the winter's snow gets melted and turned to ice. Thus, partly by thawing and freezing, and partly by pressure (but chiefly by the latter) the snow of the higher regions becomes the ice of the glacier.

It might be supposed that such an apparently hard and brittle substance as ice would refuse to move downhill, and hence it is by no means easy at first to understand how ice can flow down valleys as it does. The mean daily rate of movement of the *Mer de Glace* (in the

centre) during the summer months, is as much as 20 to 27 inches. The question is—how is such a flow to be accounted for?

In the different theories of glacier motion that have from time to time been brought forward, some account for the flow solely by gravitation, ignoring the fact that ice is not a truly rigid body; others introduce melting, or melting and freezing; and one brought forward by J. D. Forbes attributes the river-like flow of the ice to the plastic power of the ice itself, as if it were a viscous or semi-viscous substance. These theories may be briefly indicated as follows:—

1. The celebrated *De Saussure*, a pioneer in Alpine work, whose book, "Travels in the Alps," is full of original observations, conceived that the weight of the ice might be sufficient to urge it down the slope of a valley if the sliding motion were aided by water flowing at the bottom. He regarded a glacier as a rigid mass capable of sliding down an inclined plane just as any solid body might—for instance, as a slate when loosened slides down the roof of a house. There are many objections to this simple theory; one is that there ought to be accelerated motion, which there is not. Besides, De Saussure was ignorant of certain important facts, to be noticed presently. So we may dismiss this theory.

2. *Hopkins's Theory.*—Mr. Hopkins, a well-known Cambridge mathematical coach, who applied his knowledge to several important geological problems, put forward a theory which may be described as follows: He contended that a glacier can move along a very slight slope solely by gravitation, owing to the constant dissolution of ice in contact with rock below, and the number of separate fragments into which the glacier is divided by fissures, so that freedom of motion is imparted to its several parts, somewhat resembling that of an imperfect fluid. His argument was supported by a number of ingenious experiments. He found that ice will move down a very slight slope, even a slope that the eye could not perceive. This theory was very similar to that of De Saussure, only he added to it the idea of a glacier being broken by frequent fissures into separate pieces. It is needless to say that this theory is out of harmony with the facts.

3. *Charpentier* substituted for De Sausure's sliding theory an ingenious explanation, which may be called "the Dilation Theory." The most solid ice is always permeable to water, and penetrated by innumerable fissures and capilary tubes, often extremely minute. These imbibe water (due to melting) by day, which freezes during the night, and, of course, expands in the act of congelation. This was supposed to cause a distention of the whole mass, tending to propel the glacier in the direction of least resistance, namely, forwards. Mr. Hopkins opposed this theory in several able papers. He contended that the distention—if it existed—would tend to act upwards, and increase the thickness of the glacier, rather than downwards, or in other words, down the valley.

This theory has been demolished in several ways. In the first place, colored fluids have been injected to see whether the said capillary tubes existed; but they have never been detected. Again, a glacier should, on this theory, move faster about the time of sunset, when the freezing of the water must be greatest. But this is not the case.

4. *Mozley's Theory of Expansion*

and Contraction.—Canon Mozeley noticed that the lead on some parts of the roof of Bristol Cathedral kept gradually crawling downwards, tearing up its fastenings in the act. This fact seemed very remarkable, until he explained it by showing that during the day (temperature being higher) expansion took place, while during the night contraction took place. Both these would take place chiefly in the direction of least resistance, namely, downwards. He then applied this explanation to the downward movement of glaciers. This theory was ingenious, but like the others, fails to explain all the facts.

5. *Prof. James Thomson's Theory* accounts for glacier-motion in the following manner:—The freezing point of water is affected by pressure, and relaxation of pressure will cause the water at the bottom of a Glacier to freeze, and a renewal of the pressure will cause it to thaw. His idea is that the pressure due to the weight of a Glacier thaws the ice at the bottom, and that this thawing enables the Glacier to glide downwards (by diminishing friction). Then the relaxation of pressure that follows the down-sliding causes renewed freezing until once more the glacier's own weight brings about another melting. This theory is also unsatisfactory.

6. *Croll's Molecular Melting Theory.*—This ingenious theory by the late author of "Climate and Time," is rather too subtle. Briefly, he supposed that the ice is melted molecule by molecule, each molecule becoming, for a time, changed into the liquid state, and while liquid descending; thus a flow of heat was supposed to take place through the whole mass. This is how he accounted for the apparent viscosity of ice in Glaciers.

There are now only two theories left, each of which has powerful advocates now. Some think both are true. The first is—

7. *Tyndall's Regelation Theory.*—Prof. Tyndall believes that a Glacier bends sharp turns by splitting up and freezing together again. His theory is based on Faraday's well-known discovery of regelation, a principle by which when two pieces of melting ice are brought into contact, they will freeze together. The principle of viscosity, so admirably worked out by Forbes, he considers, will only account for a part of the facts. He admits that ice behaves as if it were a viscous substance when it it subjected to *pressure alone*, but when *tension* comes into play, he thinks the analogy with a viscous body ceases. His object is to reconcile the apparrent brittleness of ice (for it is decidedly brittle in small blocks) with its power of turning corners, and other facts that seem contradictory to the idea of brittleness and rigidity. In "Heat as a Mode of Motion" he says, "The glacier widens, bends, and narrows, and its centre moves more quickly than its sides." A viscous mass would, undoubtedly, do the same. But the most delicate experiments on the capacity of ice to yield, to strain—to stretch out like treacle, honey, or tar—have failed to detect this stretching power. "Is there," he asks, "then, any other physical quality to which the power of accommodation possessed by the glacier ice may be referred?" He believes regelation is the required principle, and that the mass of ice in a glacier moves down the valley by a process of alternate rupture and healing. The gist of the regelation theory is that the ice of glaciers changes its form and preserves its continuity under *pressure*,

which keeps its particles together. But when subjected to *tension*, sooner than stretch it *breaks*, and behaves no longer as a viscous body.

8. *Forbes's Viscous Theory* is opposed by Tyndall, but has many advocates of authority. Principal J. D. Forbes discovered, by a series of measurements, that an ice-stream moved slower at the side, than at the centre, and faster in the middle, as well as more rapidly at the surface than at the bottom. Consequently he proposed the theory that ice is a plastic substance, capable of yielding to great pressure, and the more so as it approaches the melting point. This theory was not supposed to be irreconcilable with the fact that it will crack under considerable pressure. In small masses this plasticity in not noticeable, but in large masses, and under long continued pressure, it slowly yields, and will flow like a stiffly viscous fluid. In large masses like a glacier, this steady, powerful pressure is furnished by the immense weight of superincumbent ice.

Many persons consider that both Tyndall and Forbes's theories are true, and so combine the two; but to the writer it seems that the plasticity of glacier-ice under great pressure is so well proved as to render the regelation theory almost unnesessary; and according to it, there ought to be more cracks and crevasses all over glaciers, and not only in their steeper parts.

—*Knowledge.*

THE TEACHER.

THE COLORS OF WATER. II.

CARL VOGT.

I HAVE already said that pure water does not exist in Nature. It always must contain dissolved or floating substances which will change its colors. Peat waters contain brown and blackish organic matters in solution. They may be perfectly clear and transparent, but the colors which the humus acids and similar substances lend them will always produce a certain effect upon them, which will be re-enforced by the dark-brown or black colors of the bottom of the peat lakes. It has also been observed that filtered water from a blue lake on evaporation leaves a white or light gray, and that from green lakes a yellow sediment; and that thus blue lakes contain white matters and green lakes yellow ones in solution, whose colors produce with those of the water mixed tints. The difference in the colors of the Lake of Geneva and of the Bodensee is explained on this principle, but the results of the experiments on which the conclusion rests have been disputed, and there is much room for doubt on the subject. Whatever may be thought of this, it is certain that no water in Nature is perfectly clear and transparent, but is more or less turbid by the presence of other substances floating in it. That this turbidity is of

greater or less importance, that we can distinguish at greater or less depths objects swimming in the water, like fishes, or lying on the bottom, are taught by daily experience as well as by experiments which have been made by sinking solid bodies in sunlight and on cloudy days and at different seasons, or by letting down sources of light, such as burning lamps and incandescent electric lights, and ascertaining the depth at which a perceptible glimpse of them can be obtained. It is to be regretted that these as well as other experiments upon the penetrating power of light have been made only in waters not quite clear, as in a few Swiss lakes and the Mediterranean Sea. Whoever has traveled on the coasts of Norway must have been astonished at the transparency of the water in many of the fiords; it is also affirmed that in some of the North American lakes the eye can perceive objects on the bottom at the depth of several hundred metres. Visibility extends to no such depths in either the Lake of Geneva or the Mediterranean Sea. The water of the Lake of Geneva is more transparent in winter than in summer, but in this lake, as well as in the sea-waters that have been thus far examined, the extreme limits of visibility are at forty-five, and at most fifty metres' depth. Observations in diving apparatus have shown that one is there as in a blue cloud, and can only see some seven or eight metres in a horizontal direction, in exceptional cases twenty metres, and at most twenty-five metres. But the seeing man can dive with the apparatus only to a depth of thirty metres, and, although he can not see clearly, he is surrounded by diffuse light.

The light from above must therefore penetrate more deeply. A more closely approximate measurement has been made by such means as sinking sensitized photographic plates into the water, and exposing them to the light at fixed depths, or by sinking substances which are chemically acted upon, changed, or destroyed by light, so that the measure of the alteration may at the same time furnish the measure of the strength of the acting light. Photographic experiments have shown that a depth of four hundred metres in the Mediterranean Sea is the average limit to which a blackening of the plate can be verified.

Thus light penetrates to ten times as great a depth as our eye, and this is an important point—a whole zone, three hundred metres in thickness, receives light and thus also sends up rays which our eyes can not immediately distinguish, but in all probability perceives through the mixture of the color tones which they produce. It is known that there are other differences than those of blindness to certain colors in the eyes of men, and that our organs may be trained to an extraordinary degree of delicacy in the observation of the finer tints. I once visited the Gobelins tapestry factory in Paris in company with some painters; the workmen could distinguish with ease and indubitably tints which looked identical to our unskilled eyes. There must, to return to our subject, radiate up from that depth to the surface, light, of a bluish color, which makes far less impression on our eyes than the colors called warm, yellow, and red, which—especially the latter—are absorbed by the water.

It was formerly believed that total darkness reigned in the greater depths of a thousand meters and more, and that the collected colors of deep water were seen on a black ground. But, in

the light of the recent deep-sea investigations, this idea must be given up, along with the other one that once prevailed, that there is no animal life in great depths. Most animals living in dark caves have atrophied or no eyes; there are also living beings found on the surface of the earth, which hide themselves in dark places, under the ground, etc., and are blind. Similar conditions prevail in the great deeps. There are blind crustaceans there, which probably live in the mud and under stones, while others, moving animals, fishes, have large, well-formed eyes. It must be that they see, or in other words that there is light there. Whether this light is produced in the depth by means of the phosphorescent organs which many of these animals, even fishes, possess, or whether it penetrates from above, as might perhaps be concluded from the fact that some of the deep-sea animals whose organization compels them to creep on the ground have yellow and red colors on their backs, is of no importance so far as our inquiry is concerned. We can only reach the inevitable conclusion that we see the colors of water not on a dark or black ground but on one that is illuminated, if but faintly. This is of moment because, in the light of it, particles floating in water are illuminated not from above only, but from below too.

We can satisfy ourselves of the effects of the coarser floating matter of sand and mud, as well as of the fact that the color of masses of water depends to a large extent upon the color of such matter. The Arve, which flows in front of my windows, is grayish yellow in summer, and opaque, assuming a deeper color after rain-storms; in winter, on the contrary, it is green, semi-transparent, and greener and clearer the less water it carries; facts easily explainable upon principles which one of my pupils nearly established by observations continued through a whole year. In summer the Arve carries, with the surplus glacier-water, grayish-yellow fragments of the mountain rocks in great multitudes ; after heavy rains, masses of yellow mud are added to these, having been washed away from the banks of the stream. In winter the amount of sediment derived from the glaciers is small, and the blue color of the water is transformed into the green mixed color. Every glacial stream has its individual color, derived from the disintegrated rocks ; and it is not without reason that the two rivers which join at Zweilutschine, in the Bernese Oberland, are known as the Black and the White Lutschine. The one brings disintegrated white limestone, the other the emery of pulverized dark slates.

How extraordinarily strong the mixed colors produced by sedimentary matter may appear was shown me by an observation which I made at Nice at the end of December, 1889. The weather had been fine for a few days, and the sea, which I overlooked from my window to Cape Antibes, about fifteen kilometres away, had been unusually blue. Now came stormy weather, with sporadic showers in the mountains of the Var. The river, whose mouth is about six kilometres from my house, poured considerable masses of saturated ochre-colored water into the sea, and there was a sharp boundary of waves between the clay-yellow tongue which continually licked itself farther into the sea, and the deep-blue salt water. After a few hours the yellow tongue became bordered with a widening green band,

so brightly, so poisonously green, that I was induced to apply my whole stock of green (vert Paul Veronese) to the completion of a study on which I tried to fix the phenomenon as truly as possible. Under the blowing of the west wind the tongue stretched itself out farther, to the rocky shore behind the harbor of Nice, around toward the bay of Villafranca; and when I visited the latter place the next day the water appeared, not steel-blue as usual, but green, fully green; and the fishermen of the zoological station there complained that no marine animals could be found swimming around, because they had fled from the green water. The blue color returned after a few days. The green was produced by the finer yellow floating matter; the coarser particles had already sunk.

The finer matter keeps afloat for a very long time. G. Bischof put some of the flood waters of the Rhine in large casks, and deposited these in the cellar of the chemical laboratory at Bonn. The finer particles had not yet entirely settled, and the water had not become clear, after several months of absolute stillness. It is plain that in a lake, in which the continual inflow and outflow keep up a constant current, though it be slight and unremarked by ordinary observers, fishermen and rowers, these fine floating particles will never come to rest, and that, since they have a yellow color, this will appear more intense in the deeper parts, because a larger number of yellow particles are floating in the thicker layers of water there. But, farther away, the shades which the floating matters of single brooks and rivers exhibit vary endlessly between gray, yellow, and reddish, and there result the most diversified and delicately shaded mixed colors, with constant variations according to the quantity of floating matter that is carried into the water-basin. Also in the sea, which is never quiet, the fine floating matter keeps afloat for a long time, and is distributed over immensely large surfaces.

Organic matters, plants and animals, have effects similar to those of mineral substances. The shores are covered with numerous plants; they grow on the lakes in all stages of green and brown (many microscopic plants, which cover the rocks as with a slime, are yellow or brown); green plants grow on the sea-shores to a depth of thirty metres, yellow and red sea-weeds to a still greater depth, forming semblances of woods and meadows, and mingling their colors with those of the water. Even in northern seas there are numerous stationary animals, sponges, solens, mussels, masses of which develop a definite color; while visitors to southern seas are unable to say enough of the splendid colors conjured up by the coral reefs.

But even this is not all. All lakes and seas swarm with swimming or "pelagic" plants and animals. Green and yellow, one-celled, microscopic algæ are exceedingly common to a considerable depth; and green and yellow algæ sometimes come to the front in such masses that "the Red Sea" becomes no arbitrary designation, but the correct expression of an observed fact. I have seen the bay of Villafranca colored partly red by millions of swimming *Anchinia rubra* about as large as peas; I have seen mile-long strips, several metres broad, immediately along the shore on the Riviera, colored a deep royal blue by compressed masses of swimming salleemans (*Velella spirans*).

We can not absolve the transparent

swimming water organisms, from the larger medusa down to the infinitesimal microbes, from having a certain amount of influence on the color of water. We should not be able to see their crystal-clear bodies if they did not refract the rays of light in a different direction from the surrounding water. By this means they send out a multitude of refracted rays, which singly are of little importance, but in the aggregate must produce an effect through their accumulation when millions of these living beings are crowded into a cubic millimetre. To what purpose should we have in some parts of the retina of our eye a million of sensitive elements or rods to the square millimetre, if we could not seize single impressions and unite them into a view of the whole?

Finally, we will not forget the air that is mixed with the water. If we skake a viscous fluid in the air, it becomes whitish, and at last white, like milk. Yet the fluid and the air are both transparent. But the air-bubbles scattered through the water refract the light in another way. The wave looks whitish, quite white on its edges, from the inclosed air, and as the motion grows stronger the white becomes more prominent, with a greenish tone when the water is clear and the sky clouded, radiant yellow in sunshine, and clay-yellow when the water is not clear. All these tones mix with the colors of the deep, and with the mirror-colors of the surface. Thus the question of the causes of the colors of water rises to be one of the most complex problems of science as well as of art, the full solution of which has not yet been reached, in spite of the various efforts of men of science and of pictorial artists, because in order to meet the apprehension of the common eye they have to continue into a picture the endlessly changing colors and shapeless figures which the sea affords. But when I stand before a wave painted by Mazure in Paris (he is there usually called *Mazure le Vague*, the Wave-Mazure), and see how that artist, without help of shore, walls, buildings, or ships, which support the eye by their forms, shows me a wave from the sea with its reflected and refracted colors harmoniously mingled with the bottom tints issuing from the deep and with the proper color of the water itself, my arms, as they say, fall from my body. And it is then hard for me to realize that the colors of water in general are composed of a multitude of factors, among which the most important are the normal blue of pure water, the mirror-colors of the surface, the refracted colors of the moving parts, the proper colors of bodies swimming in the water, and the colors of the bottom or of only very softly illuminated parts shining up through the mass.

In this, as in everything, the principle is true that there are no simple phenomena in Nature, but that all are only the result of a number of single factors, the aggregate effect of which we observe and perceive with a very imperfect instrument—our eye. —*Translated from the German for the Pop. Sce. Monthly.*

USEFUL MATERIAL.

TO do the best work in any subject taught in our public schools, "tools" are necessary. The teacher's brain, tact, and ingenuity should be the

force to be applied to the lever, but there must necessarily be a function before this force can accomplish the lifting of the weight—the development of the child's intellect.

In the study of geography more teachers feel baffled because of lack of proper aids in books, apparatus, etc., than in almost any other subject taught in the public schools. That both teacher and pupils in many of our schools find this the least satisfying and most disagreeable branch in their work is a deplorable fact. Especially is this a condition of things to be deplored when we realize that no other subject opens wider opportunities for varied and absorbing interest than does geography. One of the great hindrances to the proper teaching of the subject is the meager supply of aids outside of the *skeleton* text-book ordinarily found in use. But there is a wealth of material within the reach of every class in geography, whether in the city or the country school, and to this end I wish to give our teachers some few hints about discovering, inventing, and collecting aids.

The first step in preparing to begin any work should be a careful consideration of our resources. In this subject of geography nature has given us unlimited resources. We need but to arouse ourselves and look around to find that we have on every hand opportunities of giving real object lessons. Do not spend an hour in a useless effort to develop an abstract idea of a waterparting when you might lead your pupils to the window and allow them to discover in the landscape before them the *real* thing itself. A careful study of the relief of the land around your school house or the town or the district will enable you to develop clear concepts of such terms as *hill, slope, basin, lowland, bottoms, valleys*, etc., etc.

Another way by which you can avail yourself of these natural resources is to start a cabinet wherein the children are invited to place all the specimens of stones, minerals, curious plants, etc., that they can find. You will find that the children will become much interested in this collection, and you will no doubt soon have many valuable and useful specimens in your cabinet. Label each specimen when brought, with the donor's name, so that it may in time be safely returned to him, if he wants it; and also this plan will secure more individual interest.

At a small expense you can place on your desk a scrap-book which can be made very valuable for preserving in convenient form for reference valuable facts, statistics, etc., etc. But even better than the scrap-book is an ordinary letter-file in which clippings from papers and magazines, and good pictures, etc., may be placed. They are so inexpensive that each teacher can afford to have two, one for clippings and one for pictures.

Valuable diagrams, tables of comparison, etc., may be copied on large sheets of manilla paper and used as charts. King suggests among others the following as good subjects for chart work:

"Population of China compared with other countries, shown in squares and colors; climate of North America by belts; the religions of Africa; a temperance chart, showing to the eye by rectangles the amount in value of liquor, bread, cloth, etc., consumed in the United States in a year; comparative height of mountains and length of rivers, etc."

Perhaps the most indispensable of all aids in geography are good reference books. Teachers are apt to feel that nothing more than the ordinary text-book work is available unless there is a school library to which the children can have access. The library is of priceless worth, but the ingenious teacher does not despair because the list of reference books is very limited, but grateful to enterprising advertisers, at once looks about her for such valuable pictures, maps, and geographical literature as she can procure by merely writing for them. She writes to the secretaries of the boards of trade of growing towns and cities and from them receives much valuable information about these cities and the surrounding country. She sends a modestly worded request to the general passenger and ticket agents of our generous railroads, and thus adds to her small stock of geographical material a surprising collection of valuable matter. Her class will thus have access to detailed information about almost every section of this great continent, and all for the asking.

If you will write to any of the addresses given below you will be surprised at the quality and quantity of geographical literature you will receive by return mail from these railways :

Rock Island: John Sebastian, Chicago, Ill., will send books on iron, steel, petroleum, glass, sunlight and moonlight, coal and coke, Voltegal, Genius of Electricity, Walt Stephen, the Genius of Steam.

Michigan Central: O. W. Ruggles, Chicago, Ill., will send a bird's-eye view map, summer tourist folder, summer note book. For fifty cents he will send you any one of these beautiful books: How to See Niagara, The Falls of Niagara, and the New Don Quixote.

Baltimore & Ohio: Chas. O. Scull, Baltimore, will send books on Deer Park, Guide to Washington, and Summer Routes. Also a map of country east of Mississippi river, for expressage.

Chicago Milwaukee & St. Paul: Geo. H. Heafford, Chicago, will send books on Northern Lakes, Game and Fish Laws of the North-West, Excelsior Springs, Dells of Wisconsin, Summer in the North-West.

Northern Pacific: Chas. S. Fee, St. Paul, Minn., will send books on Yellowstone Park, Alaska, Natural Game Preserves of North America, A Ramble through Wonderland.

Chicago & Grand Trunk: E. H. Hughes, Chicago, will send Gateways of Tourist Travel and other good books.

Fall River Line: O. H. Taylor, New York City, P. O. box 452, will send In Brightest Summer Land, St. Clair Springs, Cushing Island.

Union Pacific: E. L. Lomax, Omaha, will send books on Western Resorts, Wyoming, From Summerland to the American Alps, Colorado, Alaska, Idaho and Montana, Oregon and Washington, and Utah.

Missouri Pacific: H. C. Townsend, St. Louis, Mo., will send books on Missouri, Arkansas, Travels in Mexico, Hot Springs and Vicinity, A Zephyr from the South-West, Texas, and Summer and Winter, Health and Pleasure Resorts.

Burlington & Missouri River : J. Francis, Omaha, Neb., will send valuable little books descriptive of Nebraska, Kansas, and Colorado. Every Nebraska teacher should secure these books. Also U. S. map for the postage.

Canadian Pacific : Gen'l Passenger Agent, Montreal, will send "Westward

to the East," and a variety of maps.

Colorado Midland: Chas. S. Lee, Denver, will send the Heart of the Rockies, In Ute Pass, Around Base of Pike's Peak, Cripple Creek Gold Fields.

Denver & Rio Grande: S. K. Hooper, Denver, will send Rhymes of the Rockies, Creede to Date, Tourist's Hand Book, Manitou, and Around the Circle.

From any of the following you are likely to receive valuable matter :

Atchison, Topeka & Sante Fe: George T. Nicholson, Topeka, Kansas.

Boston & Maine : F. D. Gourley, Boston, Mass.

Chicago & Alton: D. Bowers, St. Louis, Mo.

Chicago & North-Western : R. R. Ritchie, Omaha, Neb.

Chicago, Burlington & Quincy: P. S. Eustis, Chicago.

Concord & Montreal: F. E. Brown, Montreal.

Duluth, So. Shore & Atlantic: C. B. Hibbard, Minneapolis, Minn.

Florida Southern: Walter Hawkins, Jacksonville, Fla.

Gulf, Colorado & Sante Fe: W. A. Tuley, 166 Main street, Dallas, Texas.

Louisville & Nashville: C. H. Fitzgerald, Kansas City, Mo.

Mexican Central; M. H. King, 236 South Clark street, Chicago.

Mexican National : W. E. Thurbee, 10 "Rookery," Chicago.

Nashville, Chattanooga & St. Louis: B. F. Neville, 195 S. Clark steeet, Chicago.

Rio Grande Western: W. H. Snedaker, 14 Montgomery street, San Francisco, Cal.

Southern Pacific : W. G. Neimyer, 204 Clark street, Chicago.

East Tennessee, Virginia & Georgia: B. W. Wren, Knoxville, Tenn., will send you "From the Mountains to the Gulf," and other valuable papers.

—*North-Western Journal of Ed.*

VARIATIONS IN THE LENGTH OF DEGREES.

JNO. M. SANBORN.

OUR text-book tells that owing to the flattening of the earth at the poles, degrees of latitude are longer near the poles than near the equator. Most pupils will reason this wise : If we have a wheel with 360 spokes of equal length, and set equally distant apart, then will the ends of the spokes in the rim of the wheel be 1° apart. If we flatten this wheel by shortening the spokes on two opposite sides, the ends of the shorter spokes are nearer together than the ends of the longer spokes, while the angles at the hub of the wheel remain unchanged. The pupil, of course, thinks he has proved the text-book at fault in the statement that degrees of latitude are longer at the poles than at the equator. The trouble with the pupil is that he has reasoned from a fixed center.

The following explanation, though possibly not the best that can be given, will usually make the subject clear. Suppose we have a hollow glass sphere one foot in diameter ; the circumference of this sphere is a trifle more than thirty-seven inches. We divide this circumference by 360 to find the length

of a degree on the surface of the sphere, and we find that it measures a little more than a tenth of an inch, or about ten degrees to the inch. Let us now cut a circular piece one and one-half inches in diameter. This piece is 15° across. We put it into a watch for a crystal. Now, if the surface of this watch had the same curvature throughout that the crystal has, it would be twelve inches in diameter. The center of the sphere, of which the crystal is a part, is not the center of the watch. The latter lies six inches back of the crystal, and is not within the watch at all. The curve on the edge of the watch, measured from the face around toward the back, is much sharper. An arc of 180°, or a half circle, might not measure more than a half inch on the edge of the watch. And if the whole watch had the same curvature, it would be no larger than a small marble. A longitudinal section of the watch is ellipsoidal in shape, at the extremity of the longer diameter is a curve, the center of which is very near the edge of the watch.

By the flattening of the earth at the poles and the increased equatorial diameter, a given distance measured on a meridian near the equator, has a greater curvature than the same distance measured near the poles. A segment of the earth near the equator, then, is really a part of a smaller sphere than a segment of the same diameter taken from the earth at either pole. Therefore, degrees of latitude are shorter at the equator than at the poles.

If this question, "What is the distance in miles between cape Cod and cape Flattery?" were proposed to a class of average ability, we would see books opened at once to the map of the United States. The pupils observe that cape Cod is in long. 70° W., and cape Flattery in long. 125° W. By subtraction the difference of longitude is found to be 55°. The majority of the pupils would multiply 50° by 60, or 69.16, and think they had found the difference in geographic or statute miles. Many pupils of quite advanced age have never thought that degrees of longitude vary in length, simply because their attention has never been called to the fact; but when the subject is brought to their notice, they see at once that degrees are shorter on small circles of the earth that on great circles.

The question naturally arises in the mind of the pupil, and is often asked: "Is there no law governing this matter? Is there no rule by which we can determine the lengths of degrees of longitude in different latitudes?"

Suppose that we give our classes this rule: *A degree of longitude at the equator measures about 69.16 miles, and the length of the degree diminishes towards the poles as the cosine of the latitude in which it is measured diminishes.* With a little patient explanation, this rule may be made as plain to the class as it is meaningless when first given.

Step to the blackboard and draw a horizontal line, one foot in length. From the left end of this line erect a perpendicular to this line and of the same length. Using a radius of one foot, join the extremities of these lines. We have described an arc of 90°. Divide this arc into nine equal parts, commencing at the lowest number the points of division—10°, 20°, 30°, etc., up to 90°. From the right angle at the lower left hand corner of the figure, draw lines to the points of division in the arc. In drawing these lines, we have made angles of 10°, 20°, 30°, etc., at the center

of the arc, or circle, of which the arc is a part. These lines are radii of this circle. From the extremities of these radii in the arc, let fall perpendiculars upon the horizontal radius, or lowest line in our figure. These vertical lines are the sines of the various angles in our figure. The shortest one at the left hand of the figure is the sine of 10°, the next of 20°, etc. Notice that these sines increase in length as the angles increase. The sine of 30° is one half of radius, and this will be true whether the radius is one foot or one mile. Now draw lines parallel to the base line from the extremities of the radii in the arc to the vertical radius at the left side of the figure. These lines meet the vertical line at right angles, and are the cosines of the various angles in the figure. Notice that the cosines of the various angles diminish in length from 10° toward 80° just as the sines of the angles diminish, as we run from 80° downward to 10°.

The sine of 10°=cosine of 80°.

The sine of 20°=cosine of 70°.

The sine of 30°=cosine of 60°.

The sine of 45°=cosine of 45°.

The cosine of any angle equals the sine of the complement of that angle.

Show the class that there are fixed ratios between the sines and cosines of any degree and the radius of the arc, or circle, in which the angle is inscribed. Draw circles or quadrants having different radii. Inscribe, or draw similar angles in these quadrants, and notice that the sines and cosines of these angles have a fixed ratio to the radius in each figure. In each figure the cosine of 60° or the sine of 30° is one half of the radius.

At this point in the explanation, prepare for the class a table of natural sines and cosines. It will look meaningless at first, but you can easily explain that these numbers are only the ratios of the sines and cosines of the angles given in the table, to the radius of the arc or circle in which these angles are supposed to be inscribed. The cosine of the smallest angle is 1, or the same as radius, which is always considered 1 in the table. As the angles increase, the cosine diminishes, till at 90° it becomes 0°. Show your class by a few problems how to use the table. For instance, required to find the cosine of an angle of 50° in a circle, or arc, whose radius is twenty inches. From the table we find the cosine of 50° to be .64279. Multiply this by 20, the radius of our circle, and we have the required cosine. When pupils can apply this table readily in solving simple problems like the above, they are prepared to use it in determining lengths of degrees of longitude.

Place a globe before the class with its axis in a vertical position, and we will suppose that the north pole of the globe is on the upper side. Place the point of your pencil on some point on parallel 50° north latitude. Explain to the class that the cosine of 50° of latitude is a line parallel to the plane of the equator, extending from a point 50° from the equator to the earth's axis, meeting the earth's axis at right angles; and to determine the length of this line, we multiply one half of the equatorial diameter of the earth, which is radius in this problem, by .64279, the cosine of 50°. Let the class see that the cosine of any latitude is only the radius of a small circle passing around the earth in that latitude.

The circumference of one circle is to the circumference of another as the ra-

dius of the one is to the radius of the other, or the length of degrees in the circumference of one circle is to the length of degrees in the circumference of another as the radius of the one is to the radius of the other.

Suppose we wish to find the length of a degree of longitude 50° from the equator; we might state the problem in this way: 1, which represents radius, or one half of the equatorial diameter of the earth, is to .93969, the cosine of 20°, as 69.16, the length of 1° of longitude at the equator, is to the answer. Solving the proportion, we get 65.18 miles, which is approximately correct. In order to find the length of a degree of longitude in any given latitude, we have only to multiply the cosine of the latitude by 69.16.

What is the distance around the earth measured on a given parallel? What is the distance through the earth, measured on the diameter of a small circle in a given latitude? What is the shortest distance from a given point on the earth's surface to the axis of the earth?—these are some of the questions that can be readily solved by the use of a table of sines and cosines. Pupils will use this table just as easily as they will use a compound interest table or an annuity table. They will solve these problems just as understandingly as they will find the circumference of a circle by multiplying its diameter by 3.1416, or the diagonal of a square by multiplying its side by 1.41.

Do you think this is all beyond comprehension of the seventh or eighth grade pupil in geography? In the primary grades we teach pupils to draw and name geometrical figures before they ever have used a text-book in geography; may we not teach them to use a table of sines and cosines before they leave this study? Every pupil will not have a table, but you can easily procure one and direct each pupil of the geography class to copy the sines and cosines of the integral degrees from 0° to 90°. Then, occasionally, give some such problem as this. What is the length of a degree of longitude at St. Petersburg, Russia?

—*Goldthwaite's Geographical Mag.*

GRAMMAR. II.

H. B. Brown.

IN the preceding article it was shown that in grammar, as well as in any other subject, there is a definiteness which must be followed out in each subject. Attention was called particularly to *case*. The same definite plan should be followed with all the modifications of the *noun*. Call attention to the different ways a noun is used in the 1st person, 2nd person, etc. It will be found that a noun is used in the 1st person in but one way. This is when it is in apposition with a pronoun of the 1st person, as "I, James, will prepare the exercise." In this, "James" is 1st person, being in apposition with the pronoun "I." In the 2nd person the noun is used in two ways—In apposition with a pronoun of the 2nd person, and by direct address. In all other cases the noun is of the 3rd person. Of course this is little within itself, but valuable in its showing that the entire ground may be covered definitely. The most

valuable thing about it is that it does away with the wholly unsatisfactory way in which the subject is usually presented. Follow the same plan throughout. It may be said that too much attention is given to detail work. No matter, the essentials of the subject are thus learned, and besides, it cultivates *completeness* in the pupil's investigations. While the pupil is acquiring an exact knowledge of the relations, of words, he is also learning to *think*, and to think connectedly.

A number of examples may be given and practical questions asked concerning the noun, its relations to other words, its attributes, etc. These will at once present themselves to the mind of the teacher who is master of the subject.

While the subject of "substantive clauses" would in the regular work be introduced further along, yet since the readers of THE STUDENT are all familiar with the general arrangement of the topics, it will not be considered out of place to call attention to these clauses here.

Of course, the same plan would be followed as has been given with "case", "person", etc.

Let us see in how many ways a substantive clause is used.

First, as the subject of a verb, as, It was suggested that the man should return. In this the clause "the man should return" is the subject of "was suggested." It is well known that there are various ways of disposing of the word "It" in the sentence given. It is called the *apparent* subject, then used expletively, the clause being the real subject. Again, "It" is used as the subject and the clause in apposition. Again, the clause is used as the subject, and "It" in apposition. Of these views, the first is the nearest correct. However, it would seem useless to call it an *apparent* subject and then use it as an expletive. Why not use it as an expletive at once? If the second case be true, then *antecedent* does not mean antecedent. In all cases the antecedent must precede and not follow. Of course, the antecedent is often placed after the pronoun, but when the sentence is analyzed, it takes its proper place.

The third can not be correct, because a pronoun is not used to explain its antecedent.

It seems best to call "It" an expletive used for euphony to introduce the sentence. Then the clause fills its proper office.

A clause is used as a noun, secondly, as the object of a verb, as, He dreamed that *he was president*. "He was president" is a clause, the object of "dreamed."

Thirdly, as the predicate of a proposition, as, The difficulty was that he was not prepared for his work. Of course the sentence may be changed about and the clause used as the subject. It would be grammatical, but would change its attributive force. In all such cases it is better to take the sentence as it stands.

Fourthly, as the object of a preposition, as, There is much discussion about *who wrote Shakespeare*. "Who wrote Shakespeare" is a clause the object of "about." "Who" in this example is an interrogative pronoun. The discussion is not about the person who wrote Shakespeare, because then there would be no question, every one however knows that there is a discussion about "Who wrote Shakespeare."

Fifthly, in apposition, as, The text, He leadeth me beside the still waters, was

ably discussed by the preacher. Here would be a good example to show that quotation marks should not be used in case of Scriptural quotations: these begin with capitals always.

In reality the above are all of the ways in which the substantive clause will ever be found. Another is sometimes given, but it may be shown very clearly that it has an entirely different use.

SUPPLEMENTARY READING.

KATE CARVER.

"JOHN, have you nothing to do?" "No'm." "Are you certain you have all your algebra?" "Yes'm." "All your grammar?" "Yes'm."

Some such conversation, I presume, every teacher in the public schools has taken part in. It is not time for recitation, yet here is a boy with nothing to do. He thinks he has gotten all there is to get out of the lesson. His teacher may know better but has no time to convince him now. Just in front of him is a girl. Perhaps she is trying to study, perhaps not. At any rate, John can pull out her hair-pins or drop pens down her back.

I don't believe I am describing a very bad boy or a very bad school. Still, if we can, it is our duty to stop such things and each teacher must do it in his own way. I have tried several things. At first, I confess, I scolded. But, dear me, that did no good. Those very boys have told me since that they thought it fun to make me scold. Last year I tried something else and it worked so well with my school that I think others might use it with advantage. I subscribed for the Youth's Companion, took it to school, and told the pupils that it belonged to *them*. I told them that a new copy would be on my desk every Monday morning, and that I wanted them to use it. As soon as they thought they had their work done, they were given permission to come quietly to the desk and get the paper. I sometimes allowed two to sit together for the purpose of reading, and very seldom was such a privilege abused. I believe in allowing pupils as many liberties as possible. Of course, they should understand that whenever a privilege is abused, it will be taken away.

I was telling this plan to a very young prospective teacher, and was surprised to hear her say, "But won't they read the stories?" Undoubtedly they will, —they will read the stories first. But what of it? The stories are good for them. And I'm much mistaken if every word will not be read and the papers quite worn out.

However, there is an abundance of other papers which would serve the same purpose. The Week's Current would be a welcome guest in every High school or Grammar school in the country. It gives the gist of the news, boiled down and written in a style attractive to young people who have not yet learned to read newspapers properly.

Now, if anyone who reads these lines, has taken what is known as a *hard school*, I am certain that a judicious use of papers or books will help him out.

Let the teacher himself take an interest in the reading, let him speak of certain articles which will interest certain classes, let him find each day something new to read, let him tell only enough to arouse the curiosity of the pupils, and in a short time he will be surprised at the interest taken by the most indolent.

Sometimes school-boards can be induced to purchase books for the school-room. If not, the teacher will find that it will *pay* him to buy for himself. These books should be allowed pupils during school hours. For classes studying U. S. history I have used the following with good results :—Old Times in the Colonies, Boys of '76, and Building the Nation by Chas. C. Coffin; Young Folks' History of the Civil War by C. Emma Cheney.

My class in general history last year read nearly all of Miss Yonge's series of histories for young folks, Greece, Rome, Germany, France and England. Besides these, they read many biographies and miscellaneous books such as Boys' Book of Famous Rulers, Celebrated Female Sovereigns, Ben Hur, and The Last Days of Pompeii.

Of course, care must be taken that lessons are not neglected, but by proper management these can be used and a quiet, orderly school, composed of pupils who can read and like good things, be the result.

ORDER IN THE SCHOOL-ROOM.

WILLIAM KENNEDY.

THE best way to maintain good order in a school is to give the pupils plenty to do and see that they do it. Most teachers recognize this, and lessons sufficient to occupy all the pupil's time and powers are usually assigned ; but in nearly every school there are some who, apparently, will not apply themselves to the work in hand, and seem intent on wasting their own time and annoying the school by an invariable indulgence in some kind of mischievous conduct.

What to do with such pupils is a question that puzzles the minds of many teachers, and one which every teacher must decide for himself. Some teachers will scold the pupil; some will shame him; some will keep him in at recess ; some will keep him after school ; some will send a note to his parents and get him into hot water at home; some will moralize with him to make him see the error of his way, which he has seen clearly from the beginning; and some will even resort to corporal punishment. But I have to say that never have I been able to conscientiously administer any of the punishments here enumerated for the offense of educational delinquency, save keeping the pupil in at recess ; for however richly a pupil may deserve such treatment at the hands of the teacher, we must remember that his youthful and undeveloped mind is not capable of fully comprehending the justice of the teacher's demands, and not forgetting the inefficacy of such forms of punishment which were almost universally resorted to in the never-to-be-forgotten days when we ourselves were children, we must conclude that the old methods are not best and try to devise new ones.

Tell a boy in the presence of the school that if he does not study diligently you will keep him after school, chastise him, or punish him in some other way, and, though he may say nothing about it, you may depend upon it, his feelings are irreparably hurt ; he is offended. His feelings are akin to those which you or I would experience should some one, exercising temporary authority over us, accuse us of a crime in the hearing of an assemblage of our peers, and threaten punishment. So, having taken such a course, you have not only failed to conquer the boy's refractoriness, but you have made him more obstinate than before; and if you happen to be too short-sighted to see the bad effect of what you have done, you are liable to resort again and again to those harsh methods of discipline, each time lessening your own moral influence over the pupils until finally your usefulness in the school is entirely at an end.

Believing that an idle brain is the devil's workshop, I give the children so much to do that they can find no time for mischief. Then, always remembering the time-honored maxim,—"As the teacher is, so is the school,"— *I employ every moment of my own time with some useful work.* Nearly all the pupils follow my example. But yonder is a boy who is already tired of his work, though 20 minutes have not elapsed since he took his seat. I look toward him in a casual way, not constantly enough to let him know I am watching him, but often enough to observe his actions and study his motives. He looks at me, but my eyes are upon my work. Believing his actions entirely unobserved by me, he glances about the room, but there is no one with whom he can at this moment engage in a sly and mischievous intercourse. Every eye is upon the work of the day. He smiles ; he has thought of some mischief. He nudges his seatmate, who, looking up, catches my eye, and immediately resumes his work, but with less interest than before, for he is wondering what that nudge was intended for, and means to enquire as soon as my back is turned. Some mischief is already done ; and the author of it, having failed to engage the attention of his seatmate, reaches to touch the boy in front of him, but withdraws his hand ere its intended evil has been wrought, for he has observed my quiet approach. He is now looking at his lesson, apparently studying diligently; but I observe his book is upside down. The time has come when I must act, and act quickly, for if I leave him, in five minutes he will have the attention of every pupil within his reach. If I speak to him a single word of reproof, some, probably all, of the pupils will turn round to see what is up, and I become a disturbing element in the school myself.

I call his class. I ask those who have studied their lessons the most diligently to read first, then call upon him. His reading suffers in comparison,—it is wretchedly poor. I hear him spell, he misses every word. I kindly tell him that I would like to know the reason why he does not read and spell more correctly. His answer is what children will nearly always say in reply to such a question at such a time, "I can't." I know he can, but I do not question his word. I tell him that if he can't, I am very sorry, indeed, and will help him with all my heart, but will have to help him at recess, as my other time is entirely occupied with regular school work. He thinks it very kind in me to help him,

but he knows what it means. It means that he is to lose one of those three things which every healthy child wants to have in large measure,—food, sleep, and play. The most disagreeable punishment now awaits him, yet it is threatened in such a way that there is no possible ground for angry feelings or complaint on his part. He goes to his seat and thinks he would like to play in school, but he would rather play at recess. He is outgeneraled, and the battle is won. Thus a teacher needs to be wide-awake, to quickly see and promptly meet the countless little cases of discipline in school that call for an exercise of sound judgment.

—*Journal of Education.*

PRESENT STATUS OF THE METRIC SYSTEM.

PROF. DAVID C. SMITH.

WHATEVER may be the views of educators upon the advisability of teaching the metric system in the common schools, it is their duty, as it should be their pleasure, to keep informed upon the status of the system in the world at large. The English-speaking race, using, as it does, a more or less uniform set of tables, has been opposed to the French system during the whole century. Naturally, the United States would be even more conservative than England regarding it, since our commerce with nations using it is less than that of our mother country. There has, therefore, been considerable reason, in the opinion of some educators, that our people would never adopt it. However this may strike the reader, it is well to see what the system is doing elsewhere.

The second report of the New Decimal Association of England has just appeared. The association, which was established not long ago, numbers among its working members such men as Lord Kelvin, of Larzs, president of the Royal Society; Sir John Lubbock, Sir Philip Magnus, and others of equal eminence, who are known and honored in America as well as in England. The report sets forth the present status of the system. It shows that in 1890 between 300,000,000 and 400,000,000, people were using it exclusively, in round numbers about three hundred and thirty millions. According to an article in *Science*, some time since, this is a gain of about twenty-five millions in three years, and of about eighty millions in thirteen years. The report further shows that Russia began its adoption last year, that Finland put it in full use in January, and that China is seriously considering its compulsory use for her millions of people.

The movement in England appeals to the British purse in such a way as to insure interest in the system, if not its complete adoption in the future. The necessity of using it in intercourse with foreign nations is put in a very striking light. Such a strong hint as the following, from Col. Vincent's report to the master cutler at Sheffield, will not long be ignored. Col. Vincent says: "The director of the Japanese artillery (Lieut. Col. T. Ota), an experienced officer with European training, expressed himself as fully sensible of the excellence of the metal manufacturers of Sheffield, and

of their superiority in cost, quality, workmanship, and originality of design. Notwithstanding these advantages, he considered it so easy for mistakes to be made in the measurement by feet and inches, that, when exact dimensions were important, his government preferred to order their material from Creuzot, in France, and Krupp, in Germany, where the metric system is used, so that they may be relieved of trouble and anxiety." Other statements of similar tenor may be found in the consular reports of England and the United States. In short, the civilized world, outside of the English-speaking nations, uses the metric system. Every one of the smaller American republics, with which we are pushing the reciprocity policy, uses it. Within the easy memory of our younger teachers it has replaced the old measures in all scientific work in the schools and colleges of our own country. With its wonderful growth at the present time, its universal adoption must be accomplished in spite of our conservatism. The English will sometime adopt it, because it helps their trade; the Americans, because it saves time. Let the delay not trouble its advocates. The Arabic numerals struggled for over three centuries, after they were introduced into Europe, before they were taught in the schools. The decimal point, simple as it is, had to wait over a hundred years, before it found much favor.

This article must not be considered as an argument for teaching the system in the common schools, or as asserting that it is about to replace our common measures within a short time. It is merely a statement of its present use in the world. But it must be submitted that when it comes to the tables of troy and apothecary weight, or such innumerable details as the number of inches in a Winchester bushel, or such measures as the cubit, barley-corn, furlong and league, or the tables of foreign money (excepting those of England, France, and Germany), as between teaching these and the tables of the metric system, about which every well-read person, nay, every newspaper reader needs some information, there should be no question.

It may be of value to the reader to know what nations now use this system to the exclusion of others. The following is the list to date: Norway, Sweden, Finland, Denmark, Russia (beginning), Germany, Holland, Java, Belgium, France, Algeria, Senegambia, Portugal, Azores, Maderia, Spain and her colonies, Italy, Austrian territories, Greece, Roumania, Turkey (in Europe), Mexico, Central America, Haiti, Columbia, Venezuela, Ecuador, Brazil, Uruguay, Argentina, Chile, Peru, Japan.

It seems a little hard to add, opposed to this rational system, clinging to their barbarous inheritance— America and England.

—*Northwestern Journal of Education.*

PSYCHOLOGY—THE APPLICATIONS.

H. N. CARVER.

WE have already worked out a few points in regard to the logical formation of nouns, the thought-elements composing them, and have seen a few of their constructions as simple attributes. We must now try what we can do with their classification, though nothing very elaborate will be attempted, partly because of its difficulty and partly because only a practical end is aimed at.

I. Abstracts.
  A. Adjectives.
    a. Qualities.
    b. Actions.
    c. Relations.
      1. Relations proper.
      2. Conditions.
  B. Substantives.
    (Sub-classes as under the Adjectives.)

II. Concretes.
  A. Individual=proper nouns.
  B. Composites.
    a. Class nouns.
    b. Collective nouns.
    c. Mass nouns.
      1. Mass nouns proper.
      2. Attribute nouns.

The abstracts are plainly the names of attributes considered merely as attributes, without any reference to the subjects of which they are attributes,—they are the names of attributes taken absolutely, abstracted from their subjects. No doubt the subject is always implied; but as in geometry, while we say a line has no breadth or thickness, we probably mean that breadth and thickness are irrelevant matters when we are considering a line, so here subject and substance are entirely irrelevant to our purpose, which has to do with the attribute solely as attribute. The concretes are such nouns as carry a direct reference to both the attribute and its subject. If I use the term "animal," I mean to call attention not only to the attribute implied in the term but to the subject or substance as well. The term, as the logicians say, both connotes attributes and denotes things to which the the attributes belong. The question has been discussed, whether the adjective is to be regarded as abstract or concrete. If I say, "snow is white," some writers, Mill, for example, say the meaning is, "snow is one of the white things," and the term must be regarded as concrete; others think differently and say that the original meaning is, "whiteness is an attribute of snow." The question, of course, is, which is the original form of the thought, the extensive or the intensive form? It would seem that there can be little doubt that the intensive is the original form, since that is the form of the perceptive activity, and perception certainly antedates conception.

The adjective is the proper predicate-form of the name of an attribute. "Good" is the way we spell the name when we wish to use it in the predicate-construction, or in any of the others arising from the abridgement of the predicative. But very often we have oc-

casion to use the name as a subject, and then we spell it "goodness." The writers all call this form an abstract, some contending that it is the only proper abstract-form; yet so far as its office in the sentence is concerned, it is really a concrete. If I say, "goodness is always commendable," the form is the old one, subject, copula, and attribute. No doubt, the term would better be called an abstract, but the example shows how the form of thought always takes the type, and how impossible it is to escape from the old conception of a substance, much as it has been abused and much as some writers, Ruskin, for example, wish that we might escape. Here are to be classified all infinitives and gerunds, the so-called participle in -ing when used as a noun. The subclasses have been explained in a former article and may be dismissed.

Under the concretes, the proper noun has given rise to a good deal of discussion, chiefly in regard to its intension, or connotation. The subject need not be gone into here, though at some future time a separate article may be given to it. The composites are worth some attention. Perhaps the best way to see what they really are and how they differ from one another is to think of them as wholes made up of parts, a thing that is always implied when they are used, whether it is expressed or not. The class noun is always thought of as a genus of which the parts are species. It is often called the logical whole. If I am thinking of the term "tree" as a class noun, the parts are the different kinds of trees, oaks, maples, etc. Of course, it will be noticed that from the way in which species are formed out of the genus, as was explained in the May number of THE STUDENT, the species, or parts, may always be made the subjects of propositions in which the predicate will be the genus, or whole, something that cannot be done with the other kinds of nouns. Thus, the oaks are trees, etc., etc. Collective nouns are wholes whose parts are individuals. Mass nouns are wholes whose parts are mere mass parts, measured in some numerical way, so many feet, or acres, or gallons, etc. The word "tree" is not used as a collective, but I am thinking of it as a mass noun, when I think of its parts as root, stem, and branches, or as bark, wood, and pith. The term "school" is a class noun, when its parts are thought of as the various kinds of schools, public schools and private, or law schools, medical, scientific, etc.; it is a collective, when the parts are thought of as the individuals composing it; and is a mass noun, when the parts are the buildings and people attending, or the teachers and the students, etc. It will be noticed that the common noun, as defined in most of the grammars, is but the class noun. When the class noun is thought of solely in the intensive sense, as composed of an aggregate of attributes, it is very closely allied to the mass noun, so closely indeed that in logic they are analyzed by the same process, logical partition, the same principles applying whether it is thought of as a proper mass noun or as an attribute noun.

The question may be asked, what profit is there in all this? The answer must be, in one sense not much profit, in another a great deal of profit. No one who does not have the distinctions in mind, either consciously or unconsciously, can be so clear a thinker, whether writer or reader, as one who does have them. If in the same discus-

sion he uses the same term now in one sense and now in another, he is somewhat confused himself, and will confuse his reader in the end. If he is a reader and does not know how liable a writer is to fall into such confusion unconsciously, he may fail to get from his reading what he is entitled to get and what he would get, did he but know how to make allowance for the writer's oversight. Some years ago, Dr. Carpenter thought it worth while to give a large share of his inaugural address as president of the British Association to warning certain writers on scientific subjects that they were using the term "law" in an entirely unwarranted sense; he thought they were using it as if it were a concrete, whereas it is plainly only an abstract. Similarly, Darwin has been criticised, unjustly in the writer's opinion, for treating his "natural selection" in the same way. In fact, it is well nigh impossible for a writer not to take some logical liberties with his terms, which liberties will turn out innocent enough, provided the reader only knows that such lapses are likely to occur, and is willing to be fair and not to judge that he may himself not be judged.

One more article may be given to this bearing of psychology upon grammar. It is hoped that young teachers will not find it altogether "abstract" and, so, like the uses of this world to poor Hamlet, "weary, state, flat, and unprofitable."

MARS DURING THE PRESENT OPPOSITION.

W. J. Hussey.

DURING the first days of August many articles appeared in the public press concerning the present opposition of Mars and they have awakened great public interest in the present work of astronomers on this planet. It is to be regretted that, by reason of the misconceptions of the writers as to the circumstances of this opposition, many of their articles have been of a sensational character. They have indulged in extravagant hopes which will not be realized and many errors are to be found among their statements.

It seemed to be a current opinion that the present opposition is the only favorable opportunity astronomers have had to observe the planet since 1877, and, that the present time is exceedingly favorable. It also seemed to be the opinion that on the present occasion all work of value which astronomers would and could do must be done during the two or three nights immediately preceding the third of August, that being the date when Mars was nearest the earth. On the contrary Mars comes into opposition with the sun every 780 days and is observed at every opposition, the observations extending over a period of several weeks preceding and following the date of opposition. During the present summer, Mars has been regularly observed at more than one observatory since the early part of June and observations will continue to be made until the middle of September and perhaps until October. On each good night some work of permanent value will be done, but the results of this work can

not in general be at once given to the public and its results should not be expected at once. The note books of the observers may contain much in the way of drawings and remarks which would interest the public, but before these can be given in a finished form, reductions and comparisons must be made which will take time and much careful labor.

In an article in the August number of THE STUDENT the motions of the earth and Mars in their orbits and their resulting relative positions were briefly considered. It was there stated that on the third day of August Mars would be on the meridian about midnight and being then in the opposite part of the sky from the sun, would be "at opposition." It was also stated that the motions of the earth and Mars about the sun are such that oppositions of Mars recur regularly at intervals of 780 days, and since one occurred on the third of August this year, the next will occur late in September 1894, and the one following that in November 1896, and so on. At the times of opposition the illuminated portion of the planet is turned towards the earth and that such times are the most favorable for observation. At different oppositions the distance of Mars from the earth varies much, being less than 35,000,000 miles for an opposition occurring in the latter part of August and somewhat more than 61,000,000 miles for one occurring in the latter part of February. The distances at opposition occurring in other months fall between these limits. From this it appears that so far as mere distance is concerned, the most favorable ones for observation are those of August, and the most unfavorable ones those of February. But distance is not the only circumstance to be considered. There are others quite as important.

It must have been noticed by everyone that during the present summer Mars has been very far south and consequently does not rise high above our horizon. It has been from 20° to 24° south of the equator and for observatories in the southern hemisphere it is very favorably situated, for it passes near their zenith where the effects of atmospheric absorption and refraction are the least. But such is not the case in the northern hemisphere where observatories are more numerous and where all the more powerful telescopes are situated. When on the meridian Mars is now (the middle of August) only 28° above the horizon for the 36 inch telescope at the Lick Observatory, 22° for the 30 inch at Nice, 6° for the 30 inch at Pulcova, 17° for the 27 inch at Vienna, 27° for the 26 inch at Washington, 28° for the 26 inch at the University of Virginia, and 20° for Schiaparelli at Milan with his 18 inch telescope. In order then to observe the planet, astronomers in the north must now direct their telescopes well towards the horizon and in doing so look through a much greater thickness of the earth's atmosphere than would be the case if the planet were nearer the zenith. Moreover they thus look through the denser part of the atmosphere and at the same time that part which is most filled with dust and other impurities. In consequence the views of the planet are not nearly so clear as they would be were the planet even more remote but nearer the zenith.

But the chief source of difficulty in the present case comes from the fact that the earth's atmosphere is not of equal density in all its parts nor even in the same stratum, nor is it ever per-

fectly at rest. On account of the inequalities of density of the various parts, the rays of light coming from the planet proceed by different and more or less intermingling paths. Ordinarily this intermingling is greatest when the planet is at the horizon and diminishes towards the zenith. It is by means of these rays of light that the object glass of the telescope forms an image of the planet and if the rays of light are confused before reaching the telescope, the image must also be confused. Instead of a clear image, a blurred one will be the result and all the delicate features of the planet will be indistinct and perhaps invisible. The markings on Mars are not distinct. In drawings they are always overdrawn. The contrast between the darker and lighter areas is always too great. It takes careful attention to see and to determine accurately the forms and positions of even the more prominent features of the planet. It will not be surprising then to tell you that the present opposition is not so favorable as the newspapers would have us believe, but in some very important respects an unfavorable one to northern astronomers. Two years from now Mars will again be at opposition and in a more favorable situation. It will then be more remote from the earth but the difference in distance will be more than compensated by other circumstances. It will then be nearly thirty-five degrees further north and correspondingly nearer our zenith, and at the same time the position of the planet will be such that we can see more of its northern hemisphere, the region in which the so-called canals are most numerous. Its surface can then be seen better than now and in all probability more important results will be obtained than during the present summer.

The work of the present summer, unfavorable as are so many of the circumstances, is by no means unimportant. The surface is being studied with as much care as is possible and drawings are being made from night to night which when combined will fnrnish a fairly accurate map of the planet, or at least of its southern hemisphere. From the drawings made during recent oppositions it seems not improbable that there may be changes going on in the configurations of the land and water divisions of the surface. The drawings which are now being made will be of value in determining whether this is really the case.

The situation of Mars with respect to the earth is now such that more of its southern hemisphere can be seen than the northern. In fact the region surrounding the planet's north pole is now out of view and most of the northern hemisphere is in such a poor situation for observation that but little can be seen upon it.

Surrounding the poles are large white areas known as the polar caps. It is supposed that they are composed of snow and ice and the reasons for this supposition are their intensely white color and the fact that they change with the Martial seasons. They grow larger as their respective winters come on and smaller with the lengthening days of the Martial summer. The changes which have taken place in the south polar cap since the middle of June are very interesting. Early in June it was large and apparently uniformly white. It extended far from the pole and its northern limit seemed to follow closely a parallel of latitude. In July the border became irregular, and the appearance was that

which we should expect to follow a more rapid melting of the snow (we shall suppose the polar cap to be composed of snow) in some regions than in others, for example in the lowlands and over the seas. A little later dark spots appeared within the polar cap itself. These soon became larger, and indeed quite extensive. They were not of uniform darkness. Some were darker than others and not infrequently two or more of the darker regions would be connected with a lighter shading, but still darker than the white regions of the polar cap. These lighter shadings seemed in places to blend so gradually into the general whiteness of the polar cap that their endings were exceedingly difficult to determine. Of course it is easy to give an explanation of these dark areas. The melting of the snow over the polar seas and lakes and perhaps lowlands would be an amply sufficient explanation.

During July and August the polar cap has become smaller very rapidly. A part of the change is due to the change in the relative positions of the earth and Mars by which the south pole of Mars is turned somewhat from our view. But all the change can not be attributed to this. Some of it is certainly due to an actual diminution in the size of the polar cap itself.

Besides the polar caps there are other things of interest on the planet. There are the surface markings of the planet. These are the so-called continents, seas, and canals. There are large and dark areas, more or less irregular in their outlines, which have been called seas, on account of the supposition that they are bodies of water. It is, however, not certain beyond doubt that they are bodies of water. It is known that water exists on Mars, this has been shown by spectroscopic observations, and it is known that large bodies of water appear darker than land divisions. Further than this it is supposition. Surrounding the seas and greatly exceeding them in area, are whiter areas which are called continents, on the supposition that they are land. Crossing the continents usually in nearly straight lines and usually joining the inlets of the seas, are long narrow dark lines which have been called canals.

The seas and continents have been known many years, the canals are of recent discovery. It was about twenty years ago that they were first seen and the increase in our knowledge of them has been largely due to the labors of the eminent Italian astronomer, Schiaparelli. He began his studies of the planet Mars in the year 1877 and has continued them at every subseqnent opposition. Not only has he found large numbers of these so-called canals on the planet, and particularly in the northern hemisphere, but he has also discovered that they are at times double. That such is the case has been independently verified by at least four other astronomers.

During the present summer it has been difficult to see the canals at all. On several occasions, however, when the atmosphere was particularly steady and the seeing good, they could be made out. I have in my note book a number of sketches made during the past month showing them. So far as I know no one has with certainty seen them double during the present summer. This may yet be done before the present series of observations is terminated. At the next opposition the northern hemisphere of the planet will be turned in a more favorable position for observing the canals

which are so numerous upon it and we may then expect more discoveries concerning these curious markings.

During the present summer the Lick telescope has been used in making many measurements of precision on the planet and its satellites, and the excellence of the instrument has been shown by the ease and accuracy with which this work can be done. Not only are the satellites easily seen under ordinary circumstances but under circumstances somewhat extraordinary. For example, on one occassion the satellites were not only seen but their positions measured when the nearly full moon was less than a degree from Mars, that is less than two diameters of the moon from Mars. During the same evening, when the moon was a little more than a degree from the planet, I saw Phobos very clearly at a distance of less than half the diameter of Mars from the planet. The same telescope has been used to observe the eclipses of the satellites and the results have been highly satisfactory. The data which these observations furnish will be very valuable as a means of more accurately determining the motions of these little moons of Mars. It is of interest to note that it has been found practicable to observe the time at which an eclipse begins to within two-tenths of a second.

LIVING QUESTIONS.

RT. REV. SAMUEL FALLOWS.

(Delivered before the Scientific Class, Aug. 10, 1892.)

MR. President, Ladies and Gentlemen: I feel, I think, as the Queen of Sheba must have felt, as we are told in reality she did feel, when she beheld the glory of Solomon. I say I must feel as she felt, as in looking through and over this institution in its multifarious forms, that, "The half has not been told."

We in Chicago are not so far from you as not to have known more of you in detail. The time is coming when we shall be a suburb of Valparaiso, because if this electric road is finished from St. Louis to Chicago, as it will be in the course of a few months, and we can go one hundred miles an hour, it will take us, or you, I was going to say forty-one minutes,—then you would have corrected my arithmetic—only about twenty minutes to reach here. That time is coming. But as I saw this splendid file, here congregated now before you, ladies and gentlemen, coming down this aisle, ascending these stairs and taking their seats upon the platform, it seemed to me that these professors might join in the song, "Mine eyes have seen the coming of the glory of the Lord." And while they would not like to say that, why not let us say, "Thy servant depart in peace for mine eyes have seen thy salvation," because I think the Lord has a great deal of work for them yet to do in Valparaiso. Yet I think there cannot help being down deep in the hearts of all of them a perfect feeling of thanksgiving for every good and perfect gift, for the glorious work which has been accomplished here. It is certainly a magnificent thought to contemplate what has been done in the years

past, and what is now being done in this year of our Lord 1892, and with the eye of faith look down the vista of coming years and see what will be accomplished as the weeks and months roll on. Certainly from the depth of my soul I congratulate both professors and students for what I have seen and heard during the short time I have been here. Now let me say it does not take one a great while to be *en rapport* with the situation, if in any way he has had any thing to do corresponding to that which may be brought before him as an object of thought, that is if he is deeply interested in it.

I go back, I won't tell you how many years, because I have noticed that a boy, up to the age of 12 years, when asked about his age generally puts it ahead; when a man is asked about his age when he has passed the age of thirty years, as I have, why, he is not so solicitous about telling you how young or old he is. Now none of you are so hard on the ladies, as my friend the Rev. Dr. Love, of Wisconsin, a prominent Congregational minister in that state, who, when asked "why don't you say brethren and sisters when you are speaking to a mixed congregation," said, "O, there is no use of that for the brethren always embrace the sisters." I need not say anything about the ladies' ages, they can speak for themselves.

I have been getting, very rapidly, the history of most of you who are here present, especially the young men, or at least most of them. I know what you are doing in the way of self-sacrifice and in the way of self-work to help in securing your education. The marvel to me is that such facilities are afforded you, here in this beautiful town, for accomplishing the desire of your heart, that such splendid, such maximum results can be secured at such minimum financial outlay. I know it is the case with most of you, as it was with me, if it had been a college of rich men's sons, or a university of rich men's sons to which I thought of going, there would have been an absolute barrier of difficulty between myself and the attainment of my desire. But fortunately in those days we were privileged to go to a university whose terms were the lowest and which gave the students in the building and the dormitories the opportunity of boarding themselves. So I went with others to that university from my home, eighteen miles distant. The only way we could make both ends meet was by taking our provisions on our backs early Monday morning, just after the midnight hour had been struck, and then during the week with what little we could pick up here and there, doing our own cooking, go through the university course. I want to say to you that no grade of learning was ever so sweet, no draught from the Pierian spring was ever so fresh and life-giving, as during those days of poverty and effort. "God save," said a relative of mine, a professor in Harvard, years ago, "God save this institution, from ever becoming a university of rich men's sons," and God save this institution, this Normal School, this college, already in essence, from ever becoming an institution of rich men's sons, so that the one who has to toil with his own hands to gain the most precious boon of all, the honest boon, the boon of education, should be debarred from enjoying its privileges and advantages.

Now, to-night I am to speak to you on Living Questions. Allow me to say that at two periods of my life I met with

disappointment. The one in my earliest days: I had just entered the ministry and sat at the feet of an eminent bishop in the church of God, who announced as his text, Other men were tortured in accepting the deliverance that they might obtain a better resurrection. I was then studying the subject of the resurrection as many a young man has studied, and certainly I thought this eminent servant of Christ, for he was not only a bishop, but had been president of the chief theological seminary of a church which sent out scores of ministers, some of whom have been in this state and others in the union. Surely, I thought, now I shall get light on this all important subject of the "resurrection," so I took out my note-book and had my pencil all ready and was prepared to jot down what was said on the subject of the "resurrection." He referred to those Jewish mothers and fathers who saw their sons tortured to death before their eyes so that they might witness their love for God and their native land ; but when he came to the "resurrection" he said "the subject is so deep and so mysterious I must pass it by." A more disappointed young man never went out of any house at any time than I did.

My other disappointment came later in life, it came no later than last year. I was present where an assemblage almost as large as this was gathered. There stood before that assemblage a senator of the United States, a man of distinguished fame in certain directions, a man noted for his caustic wit and humor, noted also for his eloquent diction and for the breadth of his learning, who stood up before that audience speaking for nearly two hours on "The problems of the age." Ah! I thought, as I went with others to sit at his feet, a man with this experience, and with this fame discussing the living questions of the day, would give us some clue whereby we might get out of the labyrinth in which so many of us felt we were involved. And now, believe me, for two hours this subject was presented; the past was gone over; the thought was brought out that the rich are growing richer and the poor are growing poorer, every day. He brought out the fact that he himself had begun his career with the famous Jay Gould, and while one had gone to Wall Street and amassed fabulous millions, the other had gone on his way and finally gone to the senate of the United States, and then been elected to stay at home and there was a statesman without a job. But, believe me, on my honor, there was not a single work spoken, there was not a single scintillation of thought, there was not a shadow of approach to any solution of these difficult problems. We paid five hundred dollars for telling us what the problems were, and not a single effort made to give us a solution of them, except those in the past: That society has been evolved on two fundamental principles, "Root hog or die" and "The devil take the hindmost." (Suppressed applause.) Now I don't profess to be a prophet, nor the son of a prophet ; I don't hope to do much better than he did, perhaps, but still, I should be ashamed of myself if I did not at least try to do something in that direction.

Now, I don't want to be dry to-night, and I don't think the subject will be a dry one if I treat it as I ought to treat it. Yet I hardly consider myself competent to do it. But the question of all questions, from a sociological stand-

point, is that of capital and labor.

I remember a deacon who only knew one tune, and that was "Old Hundred"; no matter what tune was played or in what extraordinary manner, that was long meter doxology to him. I may say I don't know any other question, because I can usually solve every question which confronts society relating to its interests, but this very question of labor. I should like very much to discuss that fascinating and fertile question, that existing question, "The woman question". But supposing I do, it would seem vain to present now this question, the emancipation of women, the opening up to her equally with man, every avenue. Honor, profit, glory, and immortality, all these involve the labor question. And let me say in the discussion of these living questions of the age if you will think it out clearly and thoroughly, you will find this labor question is the most important of them with which we have to do. This institution with others, and perhaps I might say that this institution is the single solitary institution more than any other institution I know of in the realm of my educational acquaintance, has done much to open the doors of usefulness to women as well as to men, and yet you know that when we come to discuss this tremendous question, the labor problem, what it is doing for man. The time is already come when these fair sisters of ours shall enter into competition with the male lords of creation. And then as you follow that line of thought out,—I won't follow it for you, each one must follow it for himself—it does lead to the most tremendous issues. But I am going to wait for that bridge to come to me, and I am going to wait until good influences and good providence shall bid me to come to that bridge before I cross it.

Here in our own city, Chicago, are two persons, a young man and a young woman; they are earning now side by side ten, fifteen, or twenty dollars per week; they fall in love; they are married; twenty dollars must keep two—and more. How are we going to solve the labor problem on that basis?

Two propositions I do not believe in. To begin with I shall simply tell you I do not agree with them and then pass. First, that all wealth is created by labor; I don't believe it is tenable. I mean now manual labor, to be clear in my own definition to begin. I do believe if you mean by labor not only the toil of the hand, but the sweat of the brain, and the sweat of the heart, that it would be true, almost universally apostolic, that all wealth is created by labor, and yet not entirely true. I mean now in the use of the term labor, to-night, unless I depart from it, and you see I am departing, the labor of the hand. All wealth is not created by labor and labor alone does not give to the article its value. And a very little labor may be expended upon an article and yet it may become very valuable.

In the state of Connecticut a firm was producing a certain kind of muslin, and one of the proprietors, an inventive genius, found that by making muslin checkered instead of plain they could do something with it. They were getting for the plain muslin only eight cents per yard. The checkered was made at an infinitesimal expense by machinery and labor, and they received twenty-five cents a yard for all the mill could produce.

Now all wealth is not created by la

bor. Value is not determined by labor. Labor may or may not determine that value. The value is your want, my want; your desire, my desire, for it; what you are willing to pay for it, what I am willing to pay for it.

Secondly, I don't believe that title to all wealth ought to be vested in the laborer who produced it.

Now I throw these out, and throw them to you, and let you work out the two problems at your leisure. If you believe those two, then you will be, as I have been, termed a socialist. Now it is not a pleasant thing to contemplate that capital has been reared in open possession of the right of labor.

(*Continued next month.*)

LA PRIERE DE LA MERE.

IRMA IRSKOFF.

Our Father! Show Thou my boy the way
Within the halls of learning to-day.
May he gain within its portals wide
Knowledge, 'tis Thy hand alone, that guides
Him through the intricate paths of lore!
—Help others, Thy love to implore!
With a knowledge of faith, trust, and hope,
Give Thou wisdom and courage to cope
With worldliness, folly, and falsehood,
To battle evil, with good.

Now in the *couleur de rose* of youth,
With merry, light-heart, and words of truth,
May knowledge twine laurels on his brow,
His motto ever onward—Now.
Neath a cloudless future, record deeds
—Wrought with heart and mind
—Best efforts combined
To help the world's needs.

Wilt Thou go with my boy all the way?
—Lest the world lead him astray;
Then: Be knowledge his power, justice his
Court, honor his helm, success his port.

NOTES:—SCIENTIFIC AND OTHERWISE.

A Second of Time.

A second is the smallest division of time in general use, and when we consider that in one year there are about 31,558,000 of these periods, it would certainly seem as if it was small enough for all practical purposes. But, after all, a good deal can happen even in a fraction of a second. A light-wave, for instance, passes through a distance of about 185,000 miles in this length of time. A current of electricity has probably an even greater speed. The earth itself moves in its orbit at a rate of about twenty miles a second, thus far exceeding the fastest railroad trains on its surface. A tuning-fork of the French standard vibrates 870 times per second to produce the note *A* on the treble staff.

A Great Frozen Lake.

On the road from Irkutsk to Kiakhta, the frontier town of the Chinese empire, the terrible monotony of Mr. Price's journey was broken, for he had to cross Lake Baikal, the wonderful lake frozen for nine months in the year, which has sixty times the area of the Lake of Geneva, or 12,441 square miles, and has an average depth of no less than 5,404 feet, or more than a mile. Its origin, says Mr. Price, is undoubtedly volcanic. The cold is so terrible that when a hurricane stirs the waters, the waves often freeze as waves, remaining in hammocks above the surface; but when Mr. Price crossed the cold had caught the lake asleep, and the ice was perfectly smooth. He had thirty miles to drive on the solidified water: "For about a mile from the shore the ice had a thin layer of snow over it, but we gradually left this sort of dazzling white carpet, and at length reached the clear ice, when I saw around me the most wonderful and bewitching sight I ever beheld. Owing to the marvelous transparency of the water, the ice presented everywhere the appearance of polished crystal, and although undoubtedly of great thickness, was so colorless that it was like passing over space. It gave me at first quite an uncanny feeling to look over the side of the sledge down into the black abyss beneath; this feeling, however, gradually changed to one of fascination, till at last I found it positively difficult to withdraw my gaze from the awful depths, with nothing but this sheet of crystal between me and eternity. I believe that most travelers, on crossing the lake on the ice for the first time, experience the same weird and fascinating influence. About half way across I stopped to make a sketch and take some photographs. It was no easy matter, as I found on getting out of the sledge, for the ice was so slippery that in spite of my having felt snow boots on I could hardly stand, The death-like silence of the surroundings reminded me not a little of my experiences in the ice of the Kara Sea. This wonderful stillness was occasionally broken, however, by curious sounds, as though big guns were being fired at some little dis-

tance. They were caused by the cracking of the ice here and there. I was told that in some parts of the lake were huge fissures, through which the water could be seen. It is for this reason that it is always advisable to do the journey by daylight. We reached Moufshkaya, on the opposite coast, exactly four and a half hours after leaving Liestvenitz, the horses having done the whole distance of over thirty miles with only two stoppages of a few minutes each. It was evidently an easy bit of work for them, as they seemed as fresh when we drew up in the post yard as when they started in the morning."—*J. M. Price, "From the Arctic Ocean to the Yellow Sea."*

The World's Fair.

Commemorating the greatest event of the world's history since the birth of Christ, the exposition properly promises to distance any world's fair ever held before. How do facts bear out the assumption? For those who appreciate figures some statistics may be given. The Centennial Exposition cost about $5,000,000; the Paris Centennial of 1889 cost about $10,000,000. The last report of President Baker of the World's Columbian Exposition estimates its total cost at $22,226,403. Of this amount Chicago, through stock subscriptions and sale of four-per-cent. city bonds, has raised $11,965,456, which represents the capital stock of the exposition. Charging fifty cents entrance fee, the probable rate, Mr. Baker calculates the gate receipts at $12,500,000, allowing for as many visitors as attended the Paris Exposition. A salvage of $1,000,000 from the sale of construction material is expected. The revenue from concessions and privileges may safely be placed at $500,000. Since a large amount of this income cannot be realized in time to meet obligations, a bill has recently passed Congress appropriating $2,500,000 of a special coinage to the exposition. The coins sold as souvenirs will net at least $5,000,000. Yet after a comparison with others, this exposition cannot be called extravagant in money outlay. Its grounds are three times more extensive than those of Paris; its floor space is twice that of Paris, and five times that of the centennial; its roofs, including the live-stock pavilion, cover 153 acres, to the total of 75 covered at Paris. Eighteen thousand tons of iron and steel will be used in constructing buildings; 20 miles of water mains are being laid in the grounds, through which a daily supply of 64,000,000 gallons will be furnished; 450,000 square feet of concrete are being laid in sidewalks, which, with buildings, will be lighted with 7,000 arc and 120,000 incandescent lights. As to the success of the Columbian Exposition, should the enterprise stop with the completion of the contracts let (one year before the opening), with the applications for space now on file, and with the appropriations, State and foreign, already made, it would still result in the most notable of all such fairs ever held. However, the tale is not yet told; when it is complete it will be the frozen history of the world's progress, material, social, and ethnic; a grown-up kindergarten of universal education. Not speaking of its beneficence as a labor employer, as an impetus to industry and commerce, as a promoter of harmony and co-operation of governments, as an educator of the millions, as revealing an enlarged orbit in which woman's "sphere" readily revolves, as an incentive to American art-

growth—not dwelling upon these, who can measure its influeuce as a teacher of patriotism, showing by object-lesson the wonders of our civilization, the unfathomed powers of man as developed by a free government, and the boundless promise of the future.

—*The Chautauquan.*

Wealth in Invention.

It is an opinion of many that inventors are always poor, but such is by no means the fact. There are poor farmers, poor merchants, poor real-estate speculators, poor stock brokers, and poor bankers, but by no means are all these operators poor. It may probably be correct that as large or possibly a larger proportion of inventors are poor than of any one single class. One reason probably for this is that gentlemen of wealth are as a class not inventors, specially of those who inherited wealth or a competency. Statesmen and politicians, as a class, are not inventors of useful articles or methods. Inventors, as a class, are poor men who are desirous of acquiring a competence for support. Very few of them are ambitious for fame. Lawyers are probably the most ambitious of any one class to become distinguished statesmen. But few of them ever become inventors. Abraham Lincoln was a self-made lawyer and as a statesman probably never had an equal except possibly Thomas Jefferson. He tried invention of a steamboat, but as an inventor was a pettifogger. As wealthy inventors we might name Mr. Bessemer, of England ; Colt, of the revolver; Howe, Singer, Wheeler & Wilson, Grover & Baker—I think all of these gentlemen were part inventors in their own machines; McCormick, of the reaper; and now comes Mr. Edison and a host of others in electric lighting and electric motors too numerous to mention. Most of these are among the millionaires of to-day, while many thousands of others have either a competence or an income from their genius ample to their support. To manage a meritorious invention to a financial success requires as much skill as to produce it, and many inventors are very poor judges of honest business managers, and allow themselves to be swindled out of what they ought to have. Some years ago a man in Washington told me that he had no brains to invent, but that he watched every invention that came out, and used his skill to make money by other men's brains. The country is always full of this class, and no sooner is a patent issued, whether for a real meritorious invention or a gimcrack of no value, than the poor inventor is flooded with a lot of literature that pretends to direct him, for ten dollars or fifteen dollars, to make a fortune out of his wonderful invention. The proper place for all this printed stuff is the fire or waste basket. If an inventor has a good invention of merit, and desires means, the safe way is to go to some acquaintance of means, and he will have no trouble in securing enough to develop it and place it on the market. And I am quite sure that nearly all successful inventors have taken in partners with capital. Occasionally one can be sold out and out for a considerable sum, but these are extreme exceptions. —*Scientific American.*

THE PLATFORM.

THE ONE LEGGED GOOSE.

F. H. Smith.

"WUST scrape I eber got into wid ole Marsa John was ober Henny. She was a hurricane in dem days. She come into de kitchen once where I was helpin' git de dinner ready, an' de cook had gone to de spring house, an' she says :

" 'Chad, what ye cookin' dat smells so nice?'

" 'Dat's a goose,' I says, 'cookin' for Marsa John's dinner. We got quality,' says I, pointin' to de dinin' room do'.

" 'Quality!' she says. 'Spec' I know what de quality is; dat's for you an' de cook.'

"Wid dat she grabs a carvin' knife from de table, opens de do' ob de big oven, cuts off a leg ob be goose and dis'-pears round de kitchen corner wid de leg in her mouf.

"Fo' I knowed whar I was Marsa John come to de kitchen do' an' says : 'Gittin' late, Chad, bring in de dinner.' You see, major, dey ain't no up an' down stairs in de big house like it is here; kitchen an' dinin' room all on de same flo.'

"Well, sah, I was scared to def, but I tuk dat goose an' laid him wid de cut side down on de bottom of de pan' fo' de cook got back, put some dressin' and stuffin' ober him, an' shet de stove do'. Den I tuk de sweet potatoes an' de hominy an' put 'em on de table, an' den I went back in de kitchen to get de baked ham. I put on de ham an' some mo' dishes, an' marsa says, lookin' up :

" 'I thought dere was a roast goose, Chad?'

" 'I an't yerd nothin' 'bout no goose,' I says. 'I'll go an' ask de cook.' Next minute I yerd ol' marsa a-hollerin':

" 'Mammy Jane, an't we got a goose?'

" 'Lord-a-massy! yes, marsa. Chad, you w'uthless nigger, an't you tuk dat goose out yit?'

" 'Is we got a goose? said I.

" 'Is we got a goose? Didn't you he'p pick it?'

"I see whar my hair was short, an' I snatched up a hot dish from de hearth, opened de oven do' an' slide de goose in just as he was, an' lay him down befo' Marsa John.

" 'Now see what de ladies'll have for dinner,' says ole marsa, pickin' up his carvin' knife.

" 'What'll you take, miss?' says I. 'Baked ham?'

" 'No,' says she, lookin' up to whar Marsa John sat : 'I think I'll take a leg ob dat goose—jes so.'

"Well, marsa cut off de leg an' put a little stuffin' an' gravy on wid a spoon, an' says to me, 'Chad, see what dat gemman'll have.'

" 'What'll you take for dinner, sah? says I. 'Nice breast o' goose, or slice o' ham?'

" 'No; I think I'll take a leg ob dat goose.'

"I didn't say nuffin', but I knowed

bery well he wa'nt agwine to get it.

"But, major, you oughter seen ole marsa lookin' for de udder leg ob dat goose! He rolled him ober on de dish, dis way and dat way, an' den he jabbed dat ole bone-handled carvin'-fork in him an' hel' him up ober de dish an' looked under him an' top ob him, an' den he says, kinder sad-like:

" 'Chad, whar is de udder leg ob dat goose?'

" 'It didn't hab none,' says I.

" 'You mean to say, Chad, dat de gooses on my plantation on'y got one leg?'

" 'Some ob 'em has an' some ob 'em an't. You see, marsa, we got two kinds in de pond, an' we was a little hurried to-day, so Mammy Jane she cooked dis yere one 'cause I cotched it fust.'

" 'Well,' said he, lookin' like he look when he send for you in de little room, 'I'll settle wid ye after dinner.'

"Well, dar I was shiverin' an' shakin' in my shoes, an' droppin' gravy an' spillin' de wine on de table cloth, I was dat shuck up; an' when de dinner was ober he calls all de ladies an' gemmen an' says: 'Now come down to de duck pond. I'm gwine to show dis nigger dat all de gooses on my plantation got mo' den one leg.'

"I followed 'long, trapesin' after de whole kit an' b'ilin', an' when we got to de pond"—here Chad nearly went into a convulsion with suppressed laughter—"dar was de gooses sittin' on a log in de middle ob dat ole green goose pond wid one leg down—so—an' de udder tucked under de wing."

Chad was now on one leg, balancing himself on my chair, the tears running down his cheeks.

" 'Dar, marsa,' says I, 'don't ye see? Look at dat old gray goose! Dat's de berry match ob de one we had to-day.'

"Den de ladies all hollered an' de gemmen laughed so loud dey yerd 'em at de big house.

" 'Stop, you black scoundrel!' Marsa John says, his face gettin' white an' he a-jerkin' his handkerchief 'Shoo!'

"Major, I hope to have my brains kicked out by a lame grasshopper if ebery one of 'em gooses didn't put down de udder leg!

" 'Now, you lyin' nigger,' he says, raisin' his cane ober my head, "I'll show you——'

" 'Stop, Marsa John!' I hollered; "'tan't fair; 'tan't fair.'

" 'Why an't it fair?' says he.

" 'Cause,' says I, 'you didn't say shoo to de goose what was on de table, you didn't, marsa.'

—*Century.*

THE EDITOR.

Labor and Capital.

The troubles at Homestead and Buffalo have again brought into use a term that should never be used, the conflict between labor and capital. There is no conflict between them. The laws that govern their relations are as well understood as the laws of chemistry and physics. The interests of the one are the interests of the other. The conflict is always between the laborer and the capitalist, and it always arises from either

ignorance or viciousness on the part of one or the other, or both. Two or three things both seem inclined to forget occasionally, and as is usual is such emergencies, each tries to serve himself by crippling the strength of the other. Now, whatever may be the ultimate solution of their troubles, one thing is certain, neither will subserve his own true interest by any act which impairs the efficiency of the other's organization. Every thing that distinguishes civilization from barbarism is dependent upon the organization of all social, political, and industrial energies into a form more compact than was possible in the earlier and lower state. The thing that makes the industries of the present differ most from those of fifty years ago, is this same thing. No doubt, some bad results have come from the organization of capital as we have it to-day, but they are trivial compared with the benefits conferred upon society as a whole. The cheapening of all the necessaries of life, and many luxuries too, the increase in the purchasing power of labor, and the enormous increase in its producing power, are all dependent more upon the organization of capital than upon anything else.

On the other hand, the organization of labor as represented in the various unions and associations is of quite as much significance. The productive power of capital is as much dependent upon the organization of the labor which it employs and directs, as upon its own organization, and for the very same reasons. It would probably not be too much to say that the national prosperity is as much wrapped up in the preservation of the labor unions as in the preservation of the vested rights of corporations. When we think of what these unions are designed to accomplish, we are too apt to think they do nothing but look out for the laborers' interests as antagonistic to the capltalists', or more properly the managers', interests. Some good may indeed come from that office of the unions, once in a great while it may come, since in these matters we are not very far removed from barbarism at present; and yet it is not the proper office of the unions. A nation might just as well expect to be a prosperous and powerful nation, if its citizens were mere nomads, or could be expatriated at the caprice of its ruler, be he never so wise as a man, as a business interest under like conditions. This is not the occasion for a full discussion of the subject, but it will pay our teachers of history to think the matter out to its end. There is not a laborer in any industry in the nation, who does not owe a heavy debt to such men as George M. Pullman, Proctor and Gamble, the Fairchilds, and Harper and Brothers. These men have shown how to organize industry, and to create an industrial patriotism like the political patriotism which Alfred and Washington and Lincoln created, and a patriotism none the less lofty and honorable, nor less rich in its man-ennobling fruitage. It would seem that about the best thing the plain people can now do, is to see that such men as Governor Fowler are kept in the gubernatorial chairs, for then bullets will be thrown back when a torch or brick-bat is thrown, and in the judicial chairs such men as Judge Gresham, who will hold to the strict requirements of the law all anarchists, whether at the head of a great corporation, like McLeod, or the simple dupe of his own folly, like the rioter at Buffalo.

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The First Day.

Well begun is half done is an old adage that can be relied on as mainly true. Very much depends upon the *first day* of school. The teacher must, in a measure, become acquainted with his pupils. He must learn their names and win their good opinion. First, they must be made to feel that the teacher means to try to do them good. Second, that the school is for them and not for the teacher. Third, that the teacher is there in their interest, as the agent of their parents and of the state, and that it is his duty to see that every possible means be used to prepare them to be a credit to their parents and an honor to the state. Fourth, that all discipline will have for its sole object the accomplishment of "the greatest good to the greatest number."

We would not have it inferred that these principles should be set forth in an elaborate speech or in any formal way. Let the teacher be conscious of these facts and they will mould his management and secure to him the respect and good will of his pupils, without which his work can not, in any true sense, be a success. A feeling of sympathy once established between teacher and pupil, all that follows, if done in the true spirit of the true teacher, will but tend to strengthen the bond of union. A definite plan of procedure should be previously prepared so that everything can be done with decency and in order. The teacher must never come to a standstill for the want of something to do. Nothing so tends to weaken the confidence of pupils as to see the teacher in a quandary. Every body should be put to work as soon as possible and the work should be of a proper character. Do not presume upon the ignorance of pupils. They know whether work assigned is simply to fill up the time or whether it has a practical bearing on the regular school business.

Give them something to do that will so count that when they go home after the hours of the first day have been passed, they can tell of something learned, or of something accomplished that will make them feel that the day has been a profitable one, and an interest is awakened that will have much to do with the future success of the term's work.

THE SCHOOL.

In spite of the fact that thousands of the Alumni and former students are waiting and preparing to attend the great reunion next year, there were hundreds of visitors here during Commencement week. From the first recital of the Elocution Class, Aug. 3rd, to the exercises of the Classic Class, on the 11th, the hall was crowded every evening, and the "Hill" was thronged with visitors during the day. Parents and friends from all over the Union were present, and take it all in all the Commencement of 1892 closed fittingly the most successful year we have ever had. Fully 25% more students graduated this year than in any other of the school. The exercises of the various classes were uniformly good and were a fair index of the character of the work done here. The addresses by Hon. H. D. Vories, Bishop Fallows, and Rabbi Brown, were masterly and well received. We publish, this month, the first installment of Bishop Fallows'oration, as taken by our reporters. That of Prof. Vories will follow later in the year and will be printed from his manuscript.

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Among the old students who were here to attend the Alumni banquet were O. L. Lyon, '80, J. F. Parsons, '90, M. R. Heinmiller, '88, M. E. Buellesfield, '89, Ida L. Baker, '83, J. B. Dicus, '91, Lee Tinsley, '87, F. L. Smart, '89,

Wallace Wright, '87, Hugh Glasscock, '87, F. F. Heighway, '88, Albert Baker, '85, A. E. Baker, '91, F. O. Stokoe, '90, C. C. Rogers, '91, W. A. Shaw, '90, J. A. Shannon, '86, Martin Opheim, '91, J. J. Pattee, '91, L. G. Campbell, '91, J. M. Stevens, '91, J. L. Tousey, '91, Minnie Wirt, '91, G. A. Clauser, '91, Florence Marble, '90, E. A. Perry, '84, Vernon Landon, '88, Belle Johnson, '91, Ollie Arnold New, '76, Nettie Erwin, '90, Lillian Stockwell, '88, Clara McKinstry, '92, W. H. Strayer, '89, W. W. Hinshaw, '88, Eugene Peaveler, '91, Ed. Myers, '91, Wm. Stockman, '91.

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One of the pleasantest features of Commencement week is the banquet given by Prof. Brown to the Alumni. This is usually given at his residence and is a very delightful occasion. It was made more than usually so this year by the presentation of a beautiful statue of "The Shepherd Boy" to Mr. and Mrs. Brown by the members of the association who were present. E. A. Perry, of the Classic Class of '84, was selected to present the gift. Mr. Perry gracefully presented the beautiful statue with the following :—

Fellow members of the Alumni Association, in accordance with your request, I now take the opportunity to discharge the very pleasant duty you have assigned me, of addressing, in your behalf, a few words to our honored host.

To you, sir, in the first place, we have to say that in the yearly round of our lives, we find no pleasanter spot in which to spend a happy hour, than that in which we annually enjoy your generous hospitality. We are a band of kindred spirits gathered from all the points of the compass, and bound together by a fraternal tie only less sacred than that which binds the family. Of the vast numbers that have anuually, for many years, come up from all the fair states of this great country to this seat of learning, we represent the comparative handfull that have persevered until they attained a standing that gave them a feeling of proprietorship in the fame and glory of this great institution, which you, sir, have builded. We have turned our eyes and our steps in this direc tion from the corn-fields of the north and the cotton-fields of the south, from the clattering mills of the east and the silver-ribbed mines of the west, from the farm and the store and the workshop, from the log-cabin of the poor and the mansion of the rich, and have here met on the broad level of our common humanity, and, with hopeful hearts and helpful hands, have worked toward the same ends. We have often come uncultivated in mind, uncouth in manner, and unaesthetic in dress, and have gone away cultured and polished men and women, capable of taking and filling any position in life. We believe that the power we have gained is not so much due to the mere knowledge we have acquired, as to the spirit which we have imbibed from the institution, a spirit which has been breathed into the institution itself, by that Napoleon among educators and administrators, its responsible head and organizer. There is a suggestive legend of how Antaeus, son of Neptune and Earth, wrestled with the giant Hercules. Antaeus had his strength renewed every time he eame in contact with his mother Earth, so that the giant could conquer him only by lifting him from the earth and crushing him in the air.

We are out in the world wrestling with the giant powers of darkness; and we feel our strength renewed, as did Antaeus, as often as we return to our *Alma Mater* and grasp the hand of him from whom flows her inspiration. So great is our admiration for his energy of character and administrative ability that we desire to see them displayed in a wider field as soon as his duties here will permit of his assuming others; and while in some respects there is nothing higher than a great institution of learning, in other respects the State is higher than any of its creatures; so that I believe I but express your sentiments, fellow Alumni, when I say that were I a citizen of the fair state of Indiana, as I am of the great state of Illinois, I would say to my brethren throughout her broad domain, and not only to the members of the Alumni, but to the vast number of others who have come under the influence of this institution, let us in the near future do our state the distinguished honor, and give ourselves the proud privilege of addressing her chief executive as Governor Brown.

There is an instinct in the human heart which makes it desire to bestow gifts upon the object of its affection. We, sir, have determined to gratify that desire of our souls by making you a small offering, which, while it cannot express, may yet suggest to you our feelings toward you. We ask you to accept this statue of the Shepherd Boy as one of the ornaments of your home, hoping that sometimes, when the cares of life press heavily upon you, the sight of its carelessness of attitude and restfulness of repose may bring refreshment by carrying you back, in fancy, to the days of your boyhood, when care sat lightly upon your brow, and joy was ever within hailing distance.

Nor may it be without suggestiveness to us who are here present to-day, if we are living in accordance with the principles you have endeavored to instill into our minds. If we are so living, we will circumscribe our passions and desires as rigidly as that circle circumscribes the shaft of that pedestal ; the direction it takes will symbolize our uprightness in all the walks of life; while the cold purity and solidity of its marble will symbolize the calmness and purity and dignity that should characterize our lives. The statue itself is suggestive of the Arcadian simplicity, and

rustic happiness, that comes to one when he lives close to Nature's heart. But there is a joy to be found also in the midst of a multitude ; and it is our desire that all such joy to which we feel you are entitled may come to you. Wishing you many happy returns of this anniversary we ask you to accept our offering, knowing that it will be received in the same spirit in which it is given.

BOOKS AND MAGAZINES.

Mr. Bok has succeeded in unearthing a quantity of unpublished material by Henry Ward Beecher, which will shortly be published as a series of articles in THE LADIES' HOME JOURNAL.

Two new and worthy books recently issued are APGAR'S TREES OF THE UNITED STATES (cloth, 224pp., $ 1.) and Prof. Ellwood's Table Book and Test Problems (287 pp. $1.) The former was prepared "with the idea that teachers generally would be glad to introduce into their classes work dealing with the real objects of nature, provided the subject were one of general interest, and one that could be taught successfully by those who have had no regular scientific instruction." It is written in an unusually attractive style and will be of the utmost value, not only to teachers and students, but the general reader as well. The latter is a collection of problems and their solutions, some new, many old.

THE SLOYD SYSTEM OF WOOD WORKING is the name of a new book on manual training just issued by the American Book Company. The work *Sloyd*, from the Icelandic, means dexterity or skill, and the book gives an account of the theory and, aided by well-drawn diagrams, the practical application of this system, first taught in Sweden. American teachers have shown a deep interest in educational manual work, our utilitarian notions being shown by the introduction of various systems in many of our public and private schools. It is said that several private schools of New York, Boston and San Francisco have already adopted the Swedish Sloyd. The volume, which will be sent postpaid on receipt of price, $1.00, is well-written, and should be owned by every one interested in manual training.

We have often been asked to recommend some work on physical culture and gesture, that would stand the test of the class room, and be sufficiently explicit to be understood by teachers who have had no special training in this direction : Such a book, sure to meet the wants of thousands of teachers, is PHYSICAL EDUCATION IN THE PUBLIC SCHOOLS, by R. Anna Morris, and published by the American Book Co., 258 and 260 Wabash Ave., Chicago. Write the publishers for a copy. We heartily recommend it.

The American Book Company has just brought out a new revision of MILNE'S INDUCTIVE ALGEBRA under the title HIGH SCHOOL ALGEBRA. The book is handsomely gotten up and embraces the elements of algebra as usually taught in our high schools. The large amount of space devoted to the subject of equations is a commendable feature, as the equation is the skeleton and most of the sinew of algebra. It is a very excellent book and should have a wide sale.

The ARENA for September presents a rich and varied table of contents, as will be seen from the following : *The Future of Islam*, by Ibn Ishak ; *Old Stock Days*, by James A. Herne, with full-page portrait of Mr. Herne ; *Psychical Research*, by Rev. M. J. Savage. *The Communism of Capital*, by Hon. John Davis, M. C.; The third paper in the Bacon-Shakespeare Controversy, by Edwin Reed ; *Successful Treatment of Typhoid Fever*, by Dr. C. E. Page; *Under the Dome of the Capitol*, by Hamlin Garland ; *Walt Whitman*, by Prof. Willis Boughton, Ph. D.; *Bricks without Straw*, a story of the modern West by John Hudspeth ; *A Symposium on Woman's Dress Reform*, prepared under the auspices of the National Committee of Women of the United States. The editor writes on *The Menace of Plutocracy*, and Books of the Day are critically reviewed. The ARENA should be read by thoughtful people, especially if interested in the new thought of the age and the reformative impulse of the hour.

Most readers of the September number of the ATLANTIC MONTHLY will be first attracted by the beautiful verses addressed to Oliver Wendell Holmes, on his eighty-third birthday, by John Greenleaf Whittier, now in his eighty-fifth year. It is fitting that this poem should appear in the magazine of which these two writers are now the oldest and most distinguished contributors. Mrs. Olive Thorne Miller has a paper on *The Cliff-Dwellers in the Canon*, the cliff-dwellers being not a savage tribe of men, but a flock of birds. Mr. Bishop continues his papers on *An American at Home in Europe*, and tells about *A French Moving*, *A Year in a Mediterranean Villa*, and *A House-hunting Tour in England*, Stuart Sterne has a sonnet called *Night after Night*, and Mary J. Jacques a sketch entitled *Catherine*, the Catherine in question being one of those wonderful, model servants which are believed to exist abroad, although in this country appearing only in the pages of fiction. Mr. Hale's delightful papers on *A New England Boyhood*, are devoted to his life at home, and have all the liveliness and brightness of their author, and are a really valuable picture of domestic life in New England fifty years ago. Mr. S. R. Elliott's article on *The Romance of Memory*, Miss Scudder's third paper on *Shelley's Prometheus*, Mr, Crawford's installment of his exciting serial, *Don Orsino*, not to forget a poem by Elizabeth Stuart Phelps, called *The Lost Colors* are the chief remaining contents of a well composed number.

Why Young Men Defer Marriage is the subject of an interesting article on this truth-asserting topic, by John Lambert Payne, in the September LADIES' HOME JOURNAL. Mr. Payne's paper is statistical and treats this momentous matter from every standpoint. The wife of the famous dramatist, Alexandre Dumas, is the subject of a sketch, with portrait, by Lucy Hamilton Hooper, and Laura Grover Smith gives a description of a unique firm of women lawyers in Milwaukee. Maude Haywood contributes a special illustrated paper on *The Chicago Society of Decorative Art*, and Walter H. Barrett writes comprehensively of *Women and Life Insurance*. The Rev. T. De Witt Talmage writes of *Art in the Old World*, and Mrs. Lyman Abbott discusses many topics intelligently and well. Robert J. Burdette writes refreshingly of *Home Sweet Home* and Mrs. Mallon gives some *Hints to Elderly Women*. The always interesting departments by competent editors conclude a number which is more than usually attractive, and one that cannot fail to please its hundreds of thousands of readers.

THE OVERLAND MONTHLY for September is marked by able descriptive articles and excellent short stories. The number is appropriate to the California Admission Day celebration, with its poems on various attractive localities of the State and the amusing story, A Bare-Faced Deception, by Charles E. Brimblecom, founded on the annual celebration of the the Native Sons of the Golden West.

The leading article is a description of the Farallon Islands, by Charles S. Greene. Mrs. Eames continues her Staging in the Mendocino Redwoods, and introduces the reader to some quaint characters of the region. The article is elaborately illustrated with beautiful photographs and artistic sketches.

September is the sportman's month, and the OVERLAND publishes another article of the outing series which it has been running of late. J. A. A. Robinson's article on Quail and Quail Shooting is an accurate description of the California sport, well illustrated by Walter's vivid sketches.

Mr. John S. Hittell, the well-known historian, contributes a paper that he calls *An Interesting Historical Discovery*, in which he claims to have discovered the real cause of the fall of the Roman Empire. The Wrong Trump, by Emma A. Thurston, is an interesting mining story.

The September WIDE AWAKE is a bright, descriptive and story-telling number full of strength and excellence. Prominent among its illustrated papers is a charming description by Frances

A. Humphrey, of Old Plymouth and Plymouth Rock as they look to young tourists, under the title of *A Red Letter Day*, profusely illustrated. A paper by S. G. W. Benjamin on *Our Lighthouses and Lightships*, is full of new and interesting material about these guardians of our coasts. *Christyann's Rezavoy Picnic* is by Mary Hartwell Catherwood, and is as bright and homely as are all her character stories; Sophie May, dear to all girl readers, has a real girl story *Patient Kysie*, with the real home flavor; and Theron Brown commemorates this bi-centennial year of the Salem Witchcraft by a strong and stirring story of life at that troublous time, *John Alden's Peril*. Jennie E. Thompson has a second paper about our *Summer Sweethearts*—the birds of our farms and dooryards. Mrs. True's cute *Elf* who is fast growing dear to all the children, finds the philosopher's stone. Lt.-Col. Thorndike tells about his *Night with a Chinese Prefect*, and the fine serials by Kirk Munroe and Kate Upson Clark keep up their brightness and their interest unchanged.

PETERSON'S MAGAZINE for September is a star number from beginning to end. It is beautifully and copiously illnstrated and the literary portion cannot be too highly praised. *Miss Calline*, by Robert C. V. Meyers, is a story that would of itself make a reputation for this rapidly rising young author. *Under the Rose*, by Miss Kent, is the first installment of a novelet which promises to be admirable. *The Court of Montenegro, Home Decoration, A Sea Change*, and *'Neath Orchard Boughs* are all illustrated in a way which makes the different stories, articles and poems very attractive, and each and all deserve high praise.

WHAT THEY ARE DOING.

E. M. Brockett is conducting institutes in Kansas and Missouri.

C. C. Williamson, Scientific of '88, is teaching with success in Alliance, Neb.

C. W. Tipton will teach an 8 months' school near Cincinnati, Mo., at $40 per month.

E. E. Bishop is surveying in Wyoming, having been in the employ of the C. B. & Q. Ry ever since leaving school in 1887.

L. D. Summers has been surveying in Tipton County this summer, but goes back to Oaklandon another year at an increased salary. I like to get such word as this.

I was glad to hear from Jno. S. Barsh who was in school about 15 year ago. Mr. Barsh is doing a flourishing business in Huntington, Ind.

J. L. Tousey has secured a good position on the engineering staff of the L. S. & M. S. Ry, and is at present located at Dunkirk, N. Y.

G. A. Hawkins has resigned his position as principal of the Hebron, Ind. School, and accepted a position in the Metropolitan Business College, Chicago. He will receive a salary of $1,200.

W. H. Coleman, Elocution of '89—'90, is a candidate for the office of Clerk of Mercer Co., Mo.

In a letter to Prof. Kinsey, Jeremiah Donovan of '91 writes,—

> A short time ago I closed a successful year's work as teacher in the Carleton school. At the close of the term the school board made me a present of fifty dollars. I have contracted to teach for them again at an increased salary.

P. A. Mortenson will teach the Hanover, Ill., school at an advance of $20 per month in his salary. He is progressive, and is making a good record.

Mrs. Ella Curtis, Kindergarten of '92, writes pleasantly from Michigan, where she has been engaged this summer teaching in institutes. She will be principal of the schools of Reed Lake, the noted summer resort, this year.

O. L. Lyon has been re-engaged to the natural sciences in the Greencastle, Ind., public schools, at a greatly increased salary. He is a very popular teacher.

T. A. Hostetler writes from Fostoria, Ohio,—

I think I am located permanently, at least for awhile. I came here last May to accept a position as principal of the Commercial Department of the Normal School here, and I have just closed a contract to keep the same position next year. I like the work first rate, and it pays me $1,000 for next year.

I will have the company of Mr. J. T. Kirk, who will teach a school a few miles north of here. Mr. Kirk was here a few days ago and we could hardly get through talking about our Valparaiso exploits.

E. E. Reed has been elected principal of the Bluff Dale city schools, Bluff Dale, Texas. He has a good position, paying about $100 per month, and writes that there are excellent openings in Texas for young men of energy and ability.

I have received the announcement of the marriage of J. C. McClure and Mina Squires, on the 16th of July last. They are both graduates of the Scientific Class and held a very high standing in school. They will reside at Mulberry, Tenn. THE STUDENT extends them its very best wishes.

Another card announces the marriage of Elsie Blout of the Scientific Class of '89. Benjamin B. Knell, of Washington, D. C., is the fortunate man, and the couple will live in Washington. Congratulations.

I have also to announce the wedding of E. H. Stroeter and Miss Dora Johnson at Roodhouse, Ill., on the 25th inst. Mr. Stroeter is a personal friend of the editor, and has always been one of THE STUDENT'S staunchest supporters. May every blessing be his. The young couple will live at Liberty, Mo., Mr. Stroeter holding a good position in the public schools of that city.

E. F. O'Riordan has spent a part of the summer traveling in the West and has finally settled in Santa Fe, where he has been elected principal of one of the ward schools.

You will be glad to hear that Martin Havdal, who was forced to give up his work here on account of ill health, has quite recovered. He is living in Duluth, Minn., deeply engaged with his teaching and prohibition work. He is an enthusiastic temperance reformer.

S. N. Chenault writes,—

Since THE STUDENT has contributed largely to my enjoyment in giving an account of friends from whom I should not otherwise have heard, I will write a word from this part of the world. Alvarado (Texas) is situated in one of the highest, most healthful and progressive portions of the South-west. I am located here for a yearat least, as principal of the public schools. I anticipate a very pleasant year's work. From a neat little announcement of the Alvin Normal School and Business College, I learn that K. W. Harris is the founder of that institution.

Mr. and Mrs. G. P. Gadbury will return to Texas: Mr. Gadbury writes,—

As I am soon to change my address from Wright City, Mo., to Lebanon, Collins Co., Texas, I write you a letter stating this change so you can change the address of my STUDENT accordingly. This journal is fully up with the times and furnishes assistance in all departments of study. After receiving an issue I long for the next till it comes.

Concerning myself and wife, I will say that as I have been elected principal of Lebanon Publie Schools, we will both teach next winter, and if she likes Texas as well as I, we will make that state our home in the future. My salary will be $85 a month this year, with a probable increase for next year.

Bro. William is at home from Valpo now, and you may be sure we "quizzed" him not a little concerning our *Alma Mater* and her Faculty. Was glad to learn of your prosperity. May success crown your every effort. Will will give an elocutionary entertainment at our school house to-night, and will return to Valpo, next Tuesday.

The Dunkirk Observer, Dunkirk, Ind., prints the following complimentary notice of H. C. Risner,—

Mr. H. C. Risner, who has been connected with our public schools the past year, left for his home in Kentucky, Monday. Mr. Risner is a teacher who has the interests of the school at heart, and one of the best instructors ever in the Dunkirk schools. We are sorry to see him leave and it was the desire of the school board that his services be engaged for another year, but owing to the limited condition of the school treasury they found it impossible to meet the salary that such a teacher as Mr. Risner can command.

Mr. Risner will be in school this year.

PUBLISHER'S PAGE.

THE STUDENT.

M. E. BOGARTE, EDITOR.

H. N. CARVER, MANTIE E. BALDWIN,
ASSOCIATE EDITORS.

PUBLISHED AT

Valparaiso, Ind: No. 108 College Avenue.
Chicago, Ill: Room 15 Lakeside Building.

The Subscription Price of THE STUDENT is $1.25 a year, payable in advance.

Advertising Rates will be furnished on application.

Remittances may be made by Draft, Post-office Money Orders, Express Money Orders, or in Registered Letters. All money sent otherwise is at sender's risk. *Do not send us checks.*

The Student is issued about the first of each month. In case you fail to receive your copy by the 12th, address the publishers and a second copy will be sent.

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THE STUDENT,

108 COLLEGE AVE, VALPARAISO, IND.,
OR ROOM 15 LAKESIDE BLDG., CHICAGO, ILL.

Notice the address on the wrapper of your Journal this month. If your name is misspelled, or any other error appears, advise us on a postal card and prompt delivery through the year will be your reward.

* * *

Attention is called to the advertisements of C. H. Schub. Mr. Schub has sold a great many bicycles in Valparaiso, and his wheels have given excellent satisfaction. He has now secured large and convenient rooms in South Bend, where we will, in connection with his business, conduct a riding school. Persons desiring a reliable wheel at a reasonable price should write to him.

* * *

Ripan Tabules: for torpid liver.

* * *

Quite a large number of subscriptions expired with the August number. Renew at once. Remember that your Journal will continue to come, and the courts have decided that you are responsible for payment until you order it discontinued, *and pay arrearages in full.*

* * *

THE STUDENT is under obligation to the Star Society of this school for the thoughtful kindness of some of its members in helping to make our journal known.

* * *

Students spend, in the aggregate, a great deal of money in our city in the course of a year. All of the leading firms are represented on our advertising pages, and you confer a favor on your paper when you patronize its patrons. Remember this the next time you go "down town."

* * *

Two papers of American travel on unhackneyed subjects distinguish the September CENTURY. One of them is the first of two papers by the young explorer, E. J. Glave, giving an account of a pioneer tour of his, with packhorses, in Alaska. The other is a description of the little-known Grand Falls of Labrador by Henry G. Bryant, a member of a recent adventurous expedition to that place. Along with these outdoor articles should be mentioned Theodore Roosevelt's vivid account of *An Elk-Hunt at Two-Ocean Pass.*

A very novel subject is treated by Mr. Brander Matthews in an article on *The Pictorial Poster,* accompanied by eleven pictures of modern posters. The justification for such an article in the CENTURY is the recent artistic advance made in the preparation of posters, as shown in the examples given.

The architect Van Brunt's papers on *Architecture at the Columbian Exposition* are continued in an able and authoritative manner. The pictures which accompany these papers have the sanction of the architects, and are the latest revised representations of the various buildings.

JULY EXAMINATION QUESTIONS FOR INDIANA.

READING.

Where late the birchen wigwam stood,
Or Indian braves their game pursued,
And Indian maids were won and wooed,
By light of soft Diana;
Fair cities as by magic rise,
With church towers pointing to the skies,
And schools that charm the world's wide eyes
To fair young Indiana.—*Sarah T. Bolton.*

1. Write five questions which you would ask your pupils on the above extract. 30
2. To what extent are set rules of benefit in teaching reading? 10
3. Should reading by imitation be encouraged? Justify your answer. 10
4. Define emphasis. How may it be shown? 10
5. Read a selection indicated by the Superintendent. 40

ANSWERS.

1. (a) How long has it been since Indian tribes occupied parts of our state? (b) Tell what you can of our early history as a state. (c) What does "soft Diana" mean? (d) Tell what you can of our chief cities. (e) Schools. (f) What influence do you think churches exert on our civilization?
2. Of little benefit.
3. In spite of all that is said against it there may be much benefit derived by imitating to a judicious extent. But this requires and supposes (1) That the teacher is a good reader, (*Rara avis.*) (2) That the class is *not* to repeat line by line what the teacher reads. Read the whole selection, or at least two or three paragraphs, and by your rendition endeavor to stimulate, interest, and encourage your pupils.
4. Emphasis is the art of so expressing a word, phrase or clause, as to *distinguish* it from what precedes or follows. It is the art of making the idea to be expressed *salient.* May be done by voice or gesture, most commonly by the *falling* inflection.

ARITHMETIC.

1. Find the value of $\left(1-\frac{426}{697}+\frac{2\frac{1}{2}}{8\frac{1}{2}}\right)\div\frac{3\frac{1}{3}}{5\frac{1}{8}}$
2. How much will it cost to plaster the walls and ceiling of a room 15 feet long, 12 feet wide and 11 feet high at 32½ cents per square yard?
3. Five men in a factory accomplish as much as 8 boys: what per cent. of a man's work does a boy do? What per cent. of a boy's work does a man do?
4. What per cent. must be assessed on $1,500,000 to produce $29,400 after paying 2 per cent. for collecting?
5. A ladder 78 feet long stands perpendicularly against a building. How far must it be pulled out at the foot that the top may be lowered 6 feet?
6. The diameter of a cylindrical tank is 10½ feet, and its length is 30½. How many gallons will it hold? (231 cubic inches = 1 gallon.)
7. If interest is always computed upon the principal, how do you proceed to find the principal when the amount, time and rate are given? Why do you do so?
8. If the ceiling of a school room is 15 feet high, how many feet of floor must it have in order that 50 pupils and the teacher may each have 300 cubic feet of air?

ANSWERS.

1. $\left(1-\frac{426}{697}+\frac{2\frac{1}{2}}{8\frac{1}{2}}\right)\div\frac{3\frac{1}{3}}{5\frac{1}{8}}=\left(1-\frac{426}{697}+\frac{5}{17}\right)\times\frac{80}{123}$

$=\left(\frac{697-426+205}{697}\right)\times\frac{80}{123}=\frac{476}{697}\times\frac{80}{123}=$

$\frac{38080}{85731}=\frac{2240}{5043}$. Ans.

2. 1 wall 15 ft. long and 11 ft. high contains 165 sqnare feet.
   2 walls 15 ft. long and 11 ft. high contain 330 square feet.
   1 wall 12 ft. wide and 11 ft. high contains 132 square feet.
   2 walls 12 ft. wide and 11 ft. high contain 264 square feet.
   1 ceiling 15 feet long and 12 feet wide contains 180 square feet.
   ∴ whole surface = (330+264+180) sq. ft. or 774 sq. ft.
   774 sq. ft. = 86 sq. yds.
   86 sq. yds. @ 32½c. = $27.95. Ans.
3. 5 men = 8 boys.
   1 man = $\frac{8}{5}$ or 160% of work of 1 boy.
   8 boys = 5 men.
   1 boy = $\frac{5}{8}$ man, or 62½% of work of 1 man.
4. 2% of $29400 = $588.00
   $29400+$588 = $29988, whole am't required.
   $29988 is what % of $1,500,000?
   $1,500,000 = 100%
   1 = $\frac{1}{15000}$ per cent.
   $29988 = $\frac{29988}{15000}$ = $1\frac{3747}{3750}$%, the required rate.

5. Top point of ladder in its vertical position is 78 ft. from the ground. When lowered 6 ft., top part is 72 ft. from ground. Now, we have a right angled triangle whose alt. is 72 ft., hyp. 78 ft., to find the base.
Base $= \sqrt{(78^2-72^2)} = \sqrt{(6084-5184)} = \sqrt{900}=30$, no. of feet.

6. Area of base$=3.1416\times$rad.$^2=3.1416\times 27.5625=86.59035$, no. of sq. ft.
Volume = base $\times$ alt. $=86.59035\times 30.5 = 2641.005675$ cu. ft.
2641.005675 cu. ft.$=4,563,657.81$ cu. in.$=$ 19756.09 gal

7. (a) Divide the whole amount by the amt. of $1 for the given time at the given rate.
(b) Because this will give the sum of money which, for the given time at the given rate, will amount to the given amt.

8. 300 cu. ft. for each of 50 pupils$=15000$cu.ft. $15000\div 15=1000$, no. of sq. ft. in the floor.

PHYSIOLOGY.

(*Answer any seven.*)

1. General plan of the human body.
2. The different kinds of joints.
3. Nature and purpose of lymph.
4. The portal circulation.
5. Name the alimentary secretions and their uses.
6. Changes in air made by respiration.
7. Structure of the brain.
8. The organ of the sense of taste ; its stimulus and function.

ANSWERS.

1. A segmented endoskeleton with the soft parts enclosed within cavities and surrounding the bones. The neural cavity is dorsal, the enteric cavity is ventral and the spinal column is between these two. The whole structure is bilaterally symmetrical.
2. Hinge joint, ball and socket, pivot and gliding.
3. A fluid internal medium containing colorless blood cells. Its function is a medium of transfer between the blood vessels and the tissue cells.
4. The superior and inferior mesenteric, the splenic and gastric.
5. Saliva, function, digestion of starch.
Gastric juice, " " " proteids
Pancreatic juice, " " " fats, oils, etc.
6. Its oxygen is diminished, its carbon-dioxide increased and a varying quantity of organic gases added to it.
7. It is composed of nerve cells and nerve fibers and a connective tissue called neuroglia. The cells are aggregated into ganglia and connected by commissures. It is divided into fore- mid- and hind-brain.
8. The mucous membrane and nerve terminals of the tongue, inside of the cheeks, and upper part of the pharanx.

GEOGRAPHY.

1. Why has southern Europe a mild climate? 10
2. What physical conditions have aided in making the following large cities? New York, Paris, London, Chicago and St Petersburg. 20
3. Discuss mountains in their relation to climate. 30
4. Discuss rivers with relation to the civilization of a country. 40

ANSWERS.

1. It is subtropical, deeply indented by arms of the sea, the land slopes to the south receiving the sun's rays perpendicularly, and the Alpine system of mountains shelters it from the cold winds of the north.
2. An excellent harbor on the coast of the eastern U. S. It is the natural gateway of commerce from U. S. to Europe. Paris is in the center of a productive region and on a navigable river, the Seine, which flows into the English Channel. Chicago is the natural gate-way of the commerce of the western U. S. to the eastern portion and thence to Europe. St. Petersburg is the outlet for the products of eastern Europe.
3. They act as barriers against winds. For warm moisture laden winds they act as condensers. Rain is abundaut on the windward slopes while the opposite slopes are left dry with usually desert strips beyond. Snow and ice accumulate upon the summits forming glaciers, which in turn give rise to rivers. The condensation of moisture evaporated from the low-lands has the general effect of lowering the temperature of the climate of the earth, since the latent heat of vaporization is radiated into cold space.
4. Rivers furnish natural routes for emigration, commerce, and travel. They are also sources of power. They have fertile, well-watered, and wooded valleys and may abound in fish and other animals useful to man.

HISTORY.

1. Mention the event or achievement that rendered the name of each of the following persons famous: John Winthrop, Peter Stuyvesant, Anthony Wayne, John Ericsson, Eli Whitney.
2. Give the boundaries of what was called the North west Territory. When was the ordinance for its government passed by Congress? What was the provision of this ordinance in regard to slavery? What States have been formed of the North-west Territory?
3. Name five of the leading authors of the U. S., and give a list of the chief works of each.

4. Give a brief outline of the political events that culminated in the Civil War.
5. Give an outline of General Grant's military career during the Civil War.

ANSWERS.

1. John Winthrop, the establishment of the Massachusetts Bay Colony; Peter Stuyvesant, matters connected with the New Netherlands settlement; Anthony Wayne, the capture of Stony Point; John Ericsson, the building of the Monitor; Eli Whitney, the invention of the cotton-gin.
2. First, the Ohio and the Mississippi rivers; second, 1787; third, that slavery should be forever excluded; fourth, Ohio, Indiana, Illinois, Wisconsin, and Michigan.
3. James Russell Lowell, Ralph Waldo Emerson, George Bancroft, James Kent, John W. Draper. Such questions are hard to answer. A half-dozen other fives might be named.
4. The events can all be summed up under the one heading, the conflicting interests of free-labor and slave-labor. See Draper's History of the Civil War, vol. 1, for a discussion of the conflict.
5. First, campaign ending with the capture of Fort Donelson; second, campaign ending with the battle of Shiloh; third, capture of Vicksburg; fourth, battle of Chattanooga; fifth, campaign in Virginia ending at Appomattox.

SCIENCE OF EDUCATION.

1. Give the titles of five good treatises on education.
2. Name four American educators of more than national reputation.
3. What do we mean by the educational value of a subject.
4. Subjects have educational value because of what things?
5. Why is Geography a proper subject to have in the common schools?
6. Define: percept, concept, judgment.
7. Give the author of each of the following books: Leonard and Gertrude; Emile; Telemachus.
8. What is meant by the education of the conscience?

ANSWERS.

1. Spencer's Education, Bain's Education as a Science, McArthur's Education in its relations to Manual Industry, Painter's History of Education, Baldwin's Psychology as applied to the Art of Teaching.
2. Horace Mann, Louis Agassiz, Henry Barnard, Frederic A. P. Barnard.
3. Its efficiency in developing character-elements, intellectual, moral, and religious.
4. Because they develop interested activity along lines which lead to the higher planes of human character.
5. Because of its high educational value.
6. Percept = the product of the mind's presentative activity; it is the mental correlate of external individual things. Concept = the product of the mind's elaborative activity employed in classifying its percepts. Judgment = the product of the mind's elaborative activity employed in knowing relations of agreement, or disagreement, between two concepts. These definitions are entirely conventional.
7. Leonard and Gertrude, Pestalozzi; Emile, Rousseau; Telemachus, Fenelon.
8. The conscience is simply the judgment determining whether or not the attribute right or wrong, belongs to a given act. Its education is simply the process which enables the conscience to do its work promptly and accurately.

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10. †	8. *	24. $	4. *	12. †	6. *	LEAVE. ARRIVE.	5. *	9. *	13. †	23. $	1. *	11. †	7. *
A.M.	A.M.	P.M.	P.M.	P.M.	P.M.		A.M.	A.M.	A.M.	A.M.	P.M.	P.M.	P.M.
8 40	11 25	1 15	3 00	4 25	8 15	CHICAGO	7 30	7 37	9 45	10 00	4 50	7 00	9 30
A.M.	P.M.	P.M.	P.M.	P.M.	P.M.		A.M.	A.M.	A.M.	A. M.	P.M.	P.M.	P.M.
11 10	1 20	3 55	5 00	7 00	10 30	**VALPARAISO**	5 10	5 30	6 45	7 05	2 45	4 30	7 35
12 45	2 35		6 20		12 00	SOUTH BEND	3 35	4 00			1 20	2 50	6 20
3 20	4 30		8 20		2 40	BATTLE CREEK	1 00	1 35			11 15	12 25	4 30
5 10	5 40		9 30		4 00	LANSING	11 30	12 15			10 02	10 35	3 20
6 20	6 35		10 20		5 03	DURAND	10 30	11 20			9 05	9 30	2 35
P.M.	†P.M.				A.M.		P.M.	P.M.				A.M.	†
9 25	9 25				7 45	DETROIT	8 00	8 00				†6 50	10 50
P.M.	†P.M.				A.M.		P.M.	P.M.			A.M.		†P.M.
8 00	8 00				6 45	SAGINAW	9 00	9 00			7 55	7 55	12 18
9 56	8 50		12 25		7 30	PORT HURON	7 20	8 40			6 50	6 04	12 35
P.M.	A.M.		A.M.		P.M.			P.M.			A.M.	A.M.	A.M.
	3 10		7 30		4 10	NIAGARA FALLS		2 45			1 15		8 00
	P.M.		P.M.		A.M.			P.M.			A.M.		P.M.
	5 07		8 00		7 00	NEW YORK		9 15			10 30		6 30
	P.M.		P.M.		A.M.			P.M.			A.M.		
	10 00		9 00		7 04	PHILADELPHIA		8 30			9 00		
	P.M.		A.M.		A.M.		P.M.	P.M.			A.M.		A.M.
	9 25		8 15		9 50	BOSTON	1 00	7 00			8 30		9 00

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